Gap Analysis for the Implementation of EC Regulation 2037/2000 on Substances that Deplete the Ozone Layer

Prepared for the Environmental Protection Agency

by

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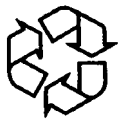

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Executive Summary

1 Overview

URS Ireland Ltd (URS) was commissioned by the Environmental Protection Agency (EPA) on behalf of the Department of the Environment, Heritage and Local Government (DEHLG) to undertake a study into the implementation of EC Regulation 2037/2000 on substances that deplete the ozone layer.

The aim of the study was to assess the measures required for Ireland to fully implement the requirements of Articles 16(5), 16(6), 17(1) and 17(2) of the Regulation.

Based on the information gathered during this study it is important to remember that Ireland is not an ozone-depleting substances (ODS) producer and is a relatively small user of these substances in an EU context. Many of the deadlines specified in the Regulation have already passed and *de facto* compliance with the Regulation exists due to the termination in the supply of certain substances.

Regulation EC 2037/2000 established rules for the production, import, export, placing on the market, use, recovery, recycling, reclamation and destruction of substances, referred to as controlled substances (CS), that deplete the ozone layer. The Regulation implements the Montreal Protocol to the Vienna Convention for the Protection of the Ozone Layer. The Regulation is more stringent that the Protocol with regard to the phasing out of CFCs, HCFCs and methyl bromide.

Substances affected by the Regulation include:

- Refrigerants
  - Chlorofluorocarbons (CFCs)
  - Hydrochlorofluorocarbons (HCFCs)
- Solvents
  - 1,1,1-Trichloroethane (methyl chloroform)
  - Tetrachloromethane (carbon tetrachloride)
  - Bromochloromethane (Halon 1011)
- Foam-blowing agents
  - Hydrochlorofluorocarbons (HCFCs)
- Firefighting agents
  - Halons (Halon 1211, 1301 and 2402)
- Pesticides
  - Methyl bromide (bromomethane or Halon 1001).

Hydrobromofluorocarbons have been employed in very few applications (UNEP, 1999) though they are included under the requirements of the Regulation in order to prevent any new uses of these compounds (as they may have been considered as replacements for other ODS).

The key objectives of the Regulation can be summarised as follows:

- Bans on the supply and use of CFCs, halons, 1,1,1-trichloroethane, carbon tetrachloride, hydrobromo-fluorocarbons and bromochloromethane. Phase-out and exemptions apply, and are described in further detail in the main body of the gap analysis.
- Increased control measures on the use of HCFCs. In addition, new controls have been applied to the supply of HCFCs. No virgin HCFCs can be used in the maintenance and servicing of refrigeration equipment after the end of 2009, with a total ban on all HCFCs from 1 January 2015.
- Increased control with regard to the recovery of ODS from products and equipment. Improved measures are also required to minimise leakages from ODS-containing systems. The measures include the setting of minimum qualification standards for personnel involved in servicing/maintaining ODS systems.
- A ban on the import of products containing ODS. This applies immediately to all ODS with the exception of HCFCs.
- A ban on the export of virgin and recycled CFCs and halons and products containing them (certain exemptions apply).

The prohibition dates for a number of use categories have already passed. The current situation in terms of using controlled substances is summarised below.

CFCs

- The use of CFCs is prohibited in all applications, with the exception of a temporary exemption authorised (until 31 December 2004) as a delivery mechanism for hermetically sealed devices designed for implantation in the human body for delivery of measured doses of medication, and until 31 December 2008 in existing military applications (where feasible alternatives are not available or cannot be used).

- CFC use as a feedstock or processing agent, as well as in essential laboratory use is still permitted. Applications for authorisations for other essential uses may be made to the Commission on an annual basis.

HCFCs

- The use of HCFCs as solvents is allowed only in the precision cleaning of electrical and other components in aerospace and aeronautics applications until 31 December 2008.

- The use of HCFCs as refrigerants is allowed under limited circumstances as detailed in Article 5(1)(c). In particular, the use of virgin HCFC in maintenance and servicing is prohibited after 31 December 2009. All HCFCs are prohibited from 2015.

- The use of HCFCs is prohibited in aerosols, for the production of foams, as a carrier gas for sterilisation substances in closed systems in equipment produced after 31 December 1997, and in all other applications not referred to above.

- HCFCs can continue to be used in laboratory use, as feedstock, as a processing agent and as a firefighting agent, subject to conditions.

Methyl bromide

- From 1 January 2005 the production and use of methyl bromide is prohibited, with the following exceptions:

  – Licensed Critical-Use Exemptions/Nominations (CUE/Ns). Applications must be made annually to the Commission for authorisation (see Article 3(2)(ii)) and for temporary emergency applications.

  – Quarantine and Preshipment (QPS) applications, subject to certain limitations on the total quantities which can be used (see Article 4(2)(iii)).

  – Use as a feedstock or processing agent.

While the use of methyl bromide from existing stocks is allowed until 31 December 2005 this is subject to clearance by the Commission (see Recommendations in Summary Gap Analysis table for methyl bromide).

Halons

- The use of halons in fire-protection systems and fire extinguishers is prohibited, other than in a limited number of critical uses detailed in Annex VII of the Regulation.

ODS solvents

- The use of ODS solvents is prohibited, with the exception of use for feedstock or as a processing agent.

It is important to note that the legislative references detailed in the text continue to be the subject of ongoing review both at EU and national level and may change in time, e.g. the Transfrontier Shipment of Waste Regulations are currently being revised. Likewise, due to the dynamic nature of technological developments and scientific progress, requirements in relation to issues such as recovery and available alternatives, etc., will change. UNEP, EU and national websites referenced should be consulted for the most up-to-date information.

The Meetings of the Parties (MOPs) to the Montreal Protocol take decisions in relation to amendments to the Protocol on the basis of new information and the ongoing work of the technical groups. As noted in the previous paragraph, it is important that the reports of the MOPs (available on the UNEP website) are checked for any updates, e.g. Decision X/14 and Decision XV/6 of MOP-10 and MOP-15, respectively, amend Annex VI in relation to uses of controlled substances as process agents.

2 Gap Analysis & Recommendations

The following pages summarise the outcomes from the gap analysis carried out as part of this project.

Summary of gap analysis for Articles 16(5), 16(6), 17(1) and 17(2) in relation to CFCs and HCFCs.

Article	Situation at the time of reporting	Recommendations
Article 16(5)		
a) Promotion of the recovery, recycling, reclamation and destruction of controlled substances **b)** Assign responsibilities for ensuring compliance with Article 16(1) **c)** Define minimum qualification requirements **d)** Report to the Commission on programmes related to qualification requirements by 31 December 2001	**a)** The Local Authorities (LAs) have been charged with the responsibility to promote the recovery, reclamation and destruction of controlled substances in domestic refrigeration equipment under the all-island scheme for the management of waste fridges. In the commercial sector promotion has largely been through companies supplying refrigeration services to clients **b)** Formal responsibility for compliance with Article 16(1) has not been assigned **c)** Minimum qualification requirements have not been defined for Ireland but there is a FÁS-based apprenticeship programme and the refrigeration industry operates its own training under the remit of the Skillnet group (www.refrigerationskillnet.ie). There is an awareness of the phase out of CFCs and HCFCs, mainly due to a lack of supply **d)** No report has been submitted to the Commission; however, this gap analysis forms part of the reporting requirements to the Commission	**General recommendation** In order to effectively implement the legislation the first measure required would be the designation of a Competent Authority (CA) by the DEHLG. It is recommended that the EPA is the most appropriate CA for this Regulation. It is also recommended that the EPA and LAs are the most appropriate enforcement bodies for refrigerants (see Section 8 of Main Report). The CA should focus in the first instance on addressing areas of non-compliance as identified in this report, on the detailed recommendations herein and prioritise reporting to the Commission using the agreed reporting format It is also recommended that the CA should implement the following actions: **a)** • Publish a Guidance Note to assist producers, users, importers, exporters and those involved in the reuse, recovery and disposal of refrigerants • Implement a focused awareness-raising campaign targeting initially the interest groups identified through this study, e.g. within industry, to provide information leaflets and advertise in trade magazines and at conferences/trade shows (see Appendix A of Main Report for contact list) **b)** • The assigned CA (the EPA, as proposed above) is formally responsible for ensuring compliance (in Ireland) with the requirements of the Regulation. The CA itself can designate responsibility to other bodies, as discussed in Section 8, which proposes an implementation strategy, establish a communication and reporting framework so that information is submitted to the LA for onward reporting to the CA and DEHLG, as necessary, to ensure recovery of ODS for destruction, recycling or reclamation (i.e. to ensure compliance with Article 16(1))

Summary *contd*

Article	Situation at the time of reporting	Recommendations
		c) • Assign responsibility to the CA to define minimum qualification requirements. Ireland may choose to modify and supplement the apprenticeship run by FÁS or adopt the industry-led approach offered by the Skillnet group (www.refrigerationskillnet.ie), or, alternatively, adapt the British scheme for certification of handlers of refrigerants to suit the situation in Ireland **d)** • Report to the Commission on defined minimum qualification requirements
Article 16(6) **a)** Report to the Commission on systems established to promote the recovery of used controlled substances by 31 December 2001 and annually thereafter **b)** Report to the Commission on the quantities of used controlled substances recovered, recycled, reclaimed or destroyed by 31 December 2001 and annually thereafter **c)** Report to the Commission on the facilities available for recovery, recycling, reclamation or destruction of used controlled substances by 31 December 2001, and annually thereafter	**a)** The DEHLG and Department of the Environment in Northern Ireland are facilitating the operation of an all-island scheme for the management of waste domestic fridges. HCFC gas is frequently recovered from redundant commercial units and recycled for use in new units. While information was issued after release of the Montreal Protocol, it is understood that there has been no further government-sponsored awareness-raising campaigns aimed at promoting the phase out of CFCs and HCFCs or the use of alternatives in Ireland on foot of Regulation 2037/2000. Limited information is available in ENFO Briefing Sheet BS25 (www.enfo.ie) on general effects of ODS, though no information is presented on disposal methods or routes for ODS-containing equipment. However, the phase out of CFCs appears to have occurred due to the lack of supply of replacement gases. No report has been made to the Commission **b)** No reporting to the Commission is carried out on the quantities of used controlled substances recovered, recycled, reclaimed or destroyed. Information on quantities of waste ODS sent out of Ireland for destruction is available through records of Transfrontier Shipment (TFS) documentation. A system is currently in place whereby the LAs report specified data from TFS documentation to the EPA (the data required are specified by the EPA) as required for the purposes of preparing the National Waste Database **c)** A system has been developed in relation to waste domestic refrigerants. There are no facilities licensed for the destruction of CFCs and HCFCs in Ireland	**a)** • Publish a Guidance Note for the industrial, commercial and domestic sector, including a list of available disposal contractors, alternatives to traditional refrigerants and details of options for replacement of ODS-containing equipment • Ensure dissemination of the Guidance Note (web, trade fairs, workshops, etc.) to relevant industrial, commercial and domestic sectors **b)** • The information required in terms of reporting obligations under Regulation 2037/2000 is already available through TFS documentation. Therefore, it is suggested that in addition to the current reports submitted to the EPA by the LAs, the LAs are also requested to separately note any specific shipments of ODS, and report these separately to the CA. **c)** • Report to the Commission on current information available and future actions planned

Summary *contd*

Article	Situation at the time of reporting	Recommendations
Article 17(1)		
a) Precautionary measures taken to prevent and minimise leaks of controlled substances **b)** Equipment with a charge of more than 3 kg shall be checked for leaks annually **c)** Define the minimum qualifications for personnel involved in leak detection **d)** Report to Commission on programmes related to qualification requirements by 31 December 2001	**a)** No measures specified at present for refrigerants **b)** Generally equipment with a charge of more than 3 kg is not routinely checked for leaks and records are not required to be maintained. Equipment likely to be covered by this requirement includes a wide range of refrigeration and air-conditioning equipment, including common units such as supermarket refrigeration systems, roof/wall-mounted air-conditioning units, etc. **c)** There have been no minimum qualifications defined for personnel involved in leak detection **d)** No report has been submitted to the Commission; however, this gap analysis forms part of the reporting requirements to the Commission	**General recommendations** • Refer in Guidance Note to techniques for preventing leakage from refrigerator and air-conditioning systems, methods of detection such as manual checks, gas analysers and alarmed pressure gauges, and maintenance and calibration requirements for electronic detection equipment. Increase the level of awareness of EN 378 *Refrigerating Systems & Heat Pumps – Safety & Environmental Requirements*. The CA should establish a reporting system to ensure that equipment with a charge of more than 3 kg is checked for leaks annually • Assign responsibility to the CA to define minimum qualification requirements. As already recommended in 16(5)(c), Ireland may choose to modify and supplement the apprenticeship run by FÁS or adopt the industry-led approach offered by the Skillnets group and take account of leak-detection techniques or, alternatively, adapt the British scheme for certification of handlers of refrigerants to suit the situation in Ireland • Report to the Commission on defined minimum qualification requirements
Article 17(2)	**Not applicable to refrigerants**	

Summary of gap analysis for Articles 16(5), 16(6), 17(1) and 17(2) in relation to halons.

Article	Situation at the time of reporting	Recommendations
Article 16(5)		
a) Promotion of the recovery, recycling, reclamation and destruction of controlled substances **b)** Assign responsibilities for ensuring compliance **c)** Define minimum qualification requirements **d)** Report to the Commission on programmes related to qualification requirements by 31 December 2001	**a)** No centrally directed promotion at present; however, recommendations for promotional measures are included in the main gap analysis report **b)** No formal assignment of responsibility at present **c)** No minimum qualifications defined and no suitable courses run in Ireland at present. It should be noted that research carried out in preparing this report indicates limited ongoing use of halon systems **d)** No report has been issued to the Commission; however, this gap analysis forms part of the reporting requirements to the Commission	**General recommendation** In order to effectively implement the legislation, the first measure required would be the designation of a Competent Authority (CA) by the DEHLG. It is recommended that the EPA is the most appropriate CA for this Regulation. It is also recommended that the EPA and LAs are the most appropriate enforcement bodies for halons (see Section 8 of Main Report). The CA should focus in the first instance on addressing areas of non-compliance as identified in this report, on the detailed recommendations herein, and prioritise reporting to the Commission using the agreed reporting format. It is recommended that the CA should implement the following actions: **a)** • Publish a Guidance Note to assist producers, users, importers, exporters and those involved in the reuse, recovery and disposal of halons • Implement a focused awareness-raising campaign targeting initially the interest groups identified through this study, e.g. within industry, to provide information leaflets and advertise in trade magazines and at conferences/trade shows (see Appendix B of Main Report for contact list) **b)** • The assigned CA (the EPA, as proposed above) is formally responsible for ensuring compliance (in Ireland) with the requirements of the Regulation. The CA itself can designate responsibility to other bodies, as discussed in Section 8 of the Main Report, which proposes an implementation strategy. Establish a communication and reporting framework so that information is submitted to the LA for onward reporting to the CA and the DEHLG, as necessary, to ensure recovery of ODS for destruction, recycling or reclamation (i.e. to ensure compliance with Article 16(1))

Summary *contd*

Article	Situation at the time of reporting	Recommendations
		c) • Assign responsibility to the CA to define minimum qualification requirements. In light of the limited halon use in Ireland at present (identified in this study), it is considered appropriate that information in the guidance document for halon (to be published by the CA) be incorporated into in-house training on the remaining uses allowed, i.e. critical uses. Include requirement in guidance document that records of in-house training are maintained, including issues covered • Require all technical work to comply with the requirements of the *Irish Standards on Safe Handling and Transfer Procedures for Halons* (IS 27201). This standard should be referenced in the guidance document and should be included as a module in any in-house training course **d)** • Report to Commission on defined minimum qualification requirements
Article 16(6) **a)** Report to the Commission on systems established to promote the recovery of used controlled substances by 31 December 2001 and annually thereafter **b)** Report to the Commission on the quantities of used controlled substances recovered, recycled, reclaimed or destroyed by 31 December 2001 and annually thereafter **c)** Report to the Commission on the facilities available for recovery, recycling, reclamation or destruction of used controlled substances by 31 December 2001 and annually thereafter	**a)** No report has been submitted. No systems established at present to promote the recovery of used halons, though contact with industry indicates limited ongoing halon use in Ireland **b)** No reporting carried out at present, though information on the quantities of halon sent out of Ireland to destruction facilities within the EU is available through records of Transfrontier Shipment (TFS) documentation. A system is currently in place whereby the LAs report specified data from TFS documentation to the EPA (the data required are specified by the EPA) as required for the purposes of preparing the National Waste Database **c)** No commercial facilities exist for the recovery of used controlled substances in Ireland. Typically, halon-containing cylinders are removed from fire-protection systems and immediately sent for destruction in the UK or other European country. Halon for disposal is reported to be sent out of Ireland via registered hazardous waste contractors. The EPA maintains data on quantities of waste transferred through records maintained from TFS documentation	**a)** • Publish a Guidance Note, including a list of available disposal contractors, alternatives and details of options for replacement of ODS-containing equipment and in particular to ensure decommissioning of non-critical halon systems and proper management of critical-use systems • Ensure dissemination of Guidance Note (web, trade fairs, workshops, etc.) to relevant sector **b)** • The information required in terms of reporting obligations under Regulation 2037/2000 is already available through TFS documentation. Therefore, it is suggested that in addition to the current reports submitted to the EPA by the LAs, the LAs are also requested to separately note any specific shipments of ODS, and report these separately to the CA **c)** • Report to Commission on current information available and future actions planned

Summary *contd*

Article	Situation at the time of reporting	Recommendations
Article 17(1) **a)** Precautionary measures taken to prevent and minimise leaks of controlled substances **b)** Define the minimum qualifications for personnel involved in leak detection **c)** Report to Commission on programmes related to qualification requirements by 31 December 2001	**a)** No measures specified at present for halon users, though Health and Safety Legislation in Ireland on *Safe Handling and Transfer Procedures for Halons* (IS 27201) should aid in minimising leakages **b)** No minimum qualifications defined for personnel involved in leak detection for halon systems **c)** No report submitted at present; however, this report forms part of the reporting requirements to the Commission. Based on information gathered during preparation of this report the number of halon users (and thus the number of personnel involved in system maintenance and leak detection) is small	**a)** • Refer in Guidance Note to techniques for preventing leakage from halon systems (e.g. pressure testing of cylinders) and methods of detection such as manual checks, gas analysers, alarmed pressure gauges **b)** • Assign responsibility to the CA to define minimum qualification requirements. In light of the limited halon use in Ireland at present (identified in this study), it is considered appropriate that information in the guidance document for halon (to be published by the CA) be incorporated into in-house training on the remaining uses allowed, i.e. critical uses. Include requirement in guidance document that records of in-house training are maintained including issues covered • Require all technical work to comply with the requirements of *Irish Standards on Safe Handling and Transfer Procedures for Halons* (IS 27201). This standard should be referenced in the guidance document and should be included as a module in any in-house training course **c)** • Report to Commission on defined minimum qualification requirements
Article 17(2)	Not applicable to halons	

Summary of gap analysis for Articles 16(5), 16(6), 17(1) and 17(2) for methyl bromide.

Article	Situation at the time of reporting	Recommendations
Article 16(5) **Article 16(6)** **Article 17(1)**	Not applicable to methyl bromide	**General recommendation** In order to effectively implement the legislation the first measure required would be the designation of a Competent Authority (CA) by the DEHLG. It is recommended that the EPA is the most appropriate CA for this Regulation. It is also recommended that the Department of Agriculture and Food is the most appropriate enforcement body for MB (see Section 8 of Main Report). The CA and the enforcement authority should focus in the first instance on addressing areas of non-compliance as identified in this report, on the detailed recommendations herein, and prioritise reporting to the Commission using the agreed reporting format
Article 17(2)		
a) All precautionary measures to be taken to prevent and minimise leakages of methyl bromide from fumigation installations and operations **b)** Virtually impenetrable films must be used during soil fumigation **c)** Define the minimum qualification requirements for personnel involved	**a)** There were no fumigation installations (i.e. purpose-built facilities for fumigation of materials) identified in Ireland. This report identifies minimal quantities of methyl bromide currently used in operations in Ireland and in these cases relevant precautionary measures are being taken. The survey did not identify any formal guidance on this topic. Teagasc has general guidance on good farming practice and there are modules within the Rural Environmental Programme (REPs) scheme in relation to pesticide application and safe use of pesticide products, though none of these deal specifically with MB usage. The Irish Pest Control Association (IPCA) also run a diploma course in pesticide use, though again this does not deal specifically with MB **b)** Soil fumigation is rarely conducted in Ireland. VIF has reportedly been used where appropriate. **c)** Minimum qualifications have not been defined and there are no formal training programmes available in Ireland on fumigation using methyl bromide. Teagasc has a general training course in relation to pesticide application and the safe use of pesticides in agriculture. The IPCA also runs a diploma course on pesticide use though neither this nor the Teagasc course deals specifically with MB usage. The National Standards Authority of Ireland (NSAI) operate a Registration Scheme for companies involved in phytosanitary treatment of wood packaging. Three companies are reported to be registered to use methyl bromide for this purpose. These companies are audited by the NSAI for the purposes of ongoing registration. Other pest-control companies (not registered by NSAI) employ in-house training or use training provided by suppliers	**a)** Publish Guidance Note for methyl bromide incorporating techniques for preventing leakages of MB during fumigations including compliance with the manufacturer's instructions. Review Teagasc Code of Practice and training courses developed by Teagasc under the REPs scheme for *Pesticide Application* and *Safe Use of Pesticide Products* and adapt if suitable/necessary for future QPS and critical-use exemptions It may also be possible to add a module to the IPCA diploma course in relation to the use of MB for QPS purposes **b)** The effective use of these films should to be referred to in the Guidance Note and should be covered in training courses. It should be stated that such use requires a critical-use exemption from the Commission **c)** Assign responsibility to the CA to define minimum qualification requirements. Expansion of the NSAI registration scheme to cover all companies involved in MB fumigation is a possible method of ensuring minimum qualification standards for MB users (see Section 6.4.3 of the Main Report). The inclusion of a module on MB usage in the IPCA diploma on pesticide usage could also be considered in forming part of a certified training programme for MB users. In addition, the inclusion of a module on MB usage in pesticide training modules offered by Teagasc could also meet training requirements in relation to the pre-harvest application of MB in agriculture and horticulture. Consideration should also be given to using material from the UNEP website, which provides a large volume of training manuals and promotional material aimed at the phase out of MB which could be adapted to suit the situation in Ireland. http://www.unepie.org/ozonaction/library/training/main.html

Summary of gap analysis for Articles 16(5), 16(6), 17(1) and 17(2) for ODS solvents.

Article	Situation at the time of reporting	Recommendations
Article 16(5)		
a) Promotion of the recovery, recycling, reclamation and destruction of controlled substances **b)** Assign responsibilities for ensuring compliance **c)** Define minimum qualification requirements **d)** Report to the Commission on programmes related to qualification requirements by 31 December 2001	**a)** There are no specific formal programmes in place to promote the recovery, recycling, reclamation or destruction of ODS solvents in particular. However, many large solvent users in Ireland are licensed under the IPC (Integrated Pollution Control) licensing system. These operators are required to employ Best Available Technology (BAT) to minimise solvent usage and release to atmosphere. Disposal of waste solvents from these sites is also regulated and must be carried out in compliance with national and EU waste legislation. Volatile Organic Compounds (VOC) usage in smaller facilities (not holding an IPC licence) may be covered by the requirements of Statutory Instrument No. 153 of 2002 *Emissions of Volatile Organic Compounds from Organic Solvents Regulations* (the Solvents Directive) which is currently being implemented in Ireland. This also specifies requirements in relation to solvent usage and emissions minimisation in a number of industry sectors. As part of the implementation of the Directive, best practice guidelines have been published for the vehicle-refinishing sector and the dry-cleaning sector, with guidance for other sectors to follow **b)** Formal responsibility for compliance with the Regulation has not been assigned **c)** Minimum qualifications have not been defined and there are no formal (certified) training programmes available in Ireland. However, a best practice guidance document for solvent use has been published by Enterprise Ireland (www.envirocentre.ie) which includes guidance on delivery, storage and distribution of solvents. The HSA also has guidance in relation to safe use of chemicals in general (www.hsa.ie) **d)** No report has been submitted; however, this gap analysis forms part of the reporting requirements to the Commission	**General recommendation** In order to effectively implement the legislation, the first measure required would be the designation of a Competent Authority (CA) by the DEHLG. It is recommended that the EPA is the most appropriate CA for this Regulation. It is also recommended that the EPA and LAs are the most appropriate enforcement bodies for ODS solvents (see Section 8 of Main Report). The CA should focus in the first instance on addressing areas of non-compliance as identified in this report, on the detailed recommendations herein, and prioritise reporting to the Commission using the agreed reporting format It is recommended that the CA should implement the following actions: **a)** • Publish a Guidance Note to assist producers, users, importers, exporters and those involved in the reuse, recovery and disposal of solvents, particularly including those involved in maintenance and servicing of equipment containing ODS solvents • Implement a focused awareness-raising campaign **b)** The assigned CA (the EPA, as suggested above) is formally responsible for ensuring compliance (in Ireland) with the requirements of the Regulation. The CA itself can designate responsibility to other bodies, as discussed in Section 8 of the Main Report, which proposes an implementation strategy. Establish a communication and reporting framework so that information is submitted to the LA for forwarding to the CA and DEHLG as necessary to ensure recovery of ODS solvents for destruction, recycling or reclamation (i.e. to ensure compliance with Article 16(1)) **c)** Assign responsibility to the CA to define minimum qualification requirements. The UNEP website provides a large volume of training manuals and promotional material aimed at the phase out of ODS which could be adapted to suit the situation in Ireland, and incorporated into a training course (see References in Section 7.6 of the Main Report) or existing training material in relation to safe use of solvents/chemicals. http://www.unepie.org/ozonaction/library/training/main.html **d)** Report to the Commission on defined minimum qualification requirements

Summary *contd*

Article	Situation at the time of reporting	Recommendations
Article 16(6)		
a) Report to the Commission on systems established to promote the recovery of used controlled substances by 31 December 2001 and annually thereafter **b)** Report to the Commission on the quantities of used controlled substances recovered, recycled, reclaimed or destroyed by 31 December 2001 and annually thereafter **c)** Report to the Commission on the facilities available for recovery, recycling, reclamation or destruction of used controlled substances by 31 December 2001 and annually thereafter	**a)** No reporting to the Commission has been carried out specifically in relation to ODS solvents. Promotion of solvent minimisation has been carried out in Ireland through the IPC licensing system, and also through the implementation of the Solvents Directive (1999/13/EC) **b)** No reporting to the Commission is carried out on the quantities of used controlled substances recovered, recycled, reclaimed or destroyed **c)** There are no commercial facilities licensed for the destruction of ODS solvents in Ireland. Several pharmaceutical sites in Ireland operate hazardous waste incinerators licensed under the IPC system and may carry out destruction of ODS solvents on site. Other solvent materials are sent to commercial incinerators in Europe under TFS documentation; hence, while records of total solvent disposal would be available, there would be no specific figures on ODS solvents. There is a proposal to construct at least one commercial hazardous waste incinerator in Ireland based on the National Hazardous Waste Management Plan	**a)** • Publish a Guidance Note for the industrial and commercial sector, including a list of available disposal contractors, alternatives to ODS solvents and details of options for replacement of ODS-containing equipment • Ensure dissemination of guidance (web, trade fairs, workshops, etc.) for the industrial and commercial sectors **b)** The information required in terms of reporting obligations under Regulation 2037/2000 is already available through TFS documentation. Therefore, it is suggested that in addition to the current reports submitted to the EPA by the LAs, the LAs are also requested to separately note any specific shipments of ODS, and report these separately to the CA **c)** Report to the Commission on current information available and future actions planned
Articles 17(1) and 17(3)		
a) All precautionary measures practicable should be taken to prevent and minimise leaks of controlled substances used as feedstock and processing agents **b)** Equipment with a refrigerating fluid charge of more than 3 kg shall be checked for leaks annually **c)** Define the minimum qualifications for personnel involved in leak detection and report to the Commission by 31 December 2001 on the programmes related to the qualification requirements	**a)** ODS solvents should now only be used as a feedstock or processing agent; hence, leakage is likely to be related mainly to storage prior to use. Guidance on delivery, storage and distribution of solvents is included in the Enterprise Ireland Guidance Note on solvents **b)** Not applicable to ODS solvents **c)** No qualification requirements have been defined in Ireland for those involved in leak detection with regard to ODS solvent-containing systems. Under the IPC licensing system all staff with responsibilities which could potentially result in environmental impact are required to undergo suitable training; hence, any such equipment in IPC-licensed facilities should be maintained by suitably qualified personnel. Equipment containing ODS solvents can no longer be imported (unless they were manufactured prior to entry into force of the Regulation); hence, the quantity of such equipment in use is expected to be small	**a)** The Guidance Note to be published by the CA will refer to Enterprise Ireland's best practice guidance document on solvents (www.envirocentre.ie) which includes best practice guidelines for delivery, storage and distribution of solvents. The manufacturer's instructions regarding the handling and use of ODS solvents typically specify measures for the prevention of leaks during use. Compliance with these instructions is considered important in meeting the requirements of the Regulation. This could also be incorporated into a user training course **b)** Assign responsibility to the CA to define minimum qualification requirements. Solvent loss prevention best practice guidance is outlined in Enterprise Ireland's best practice guidance document on solvents (www.envirocentre.ie), including information on recovery and reuse, avoiding spills and maintenance to prevent leaks. This could be used as the basis of in-house training for companies who continue to use equipment containing ODS solvents. Report to the Commission on defined minimum qualification requirements
Article 17(2)	Not applicable to ODS solvents	

3 Suggested Implementation Strategy

A number of Competent Authorities (CA) are required to be designated by each Member State under the Regulation and there is also a need for an overall lead responsibility to be designated for implementation of the Regulation. It is recommended that the EPA is the most appropriate lead body to implement and oversee enforcement of the Regulation in Ireland. The following overall enforcement/inspection structure is proposed as presented in Fig. 1.

There are a number of direct reporting responsibilities referred to in the Regulation and these are summarised in Table 1 below. Additional reporting routes recommended as part of the implementation in Ireland are detailed in Fig. 2.

Further detail on the implementation strategy is included in Section 8 of the Main Report.

4 References

UNEP, 1999. *Basic Facts and Data on the Science and Politics of Ozone Protection.*

Table 1. Reporting requirements referred to directly in the Regulation.

Article	Relevant bodies	Information outline
3	CA to notify the Commission	Reporting in relation to production authorisations
4(1)	CA request to the Commission	Request for exemption for CFC use in specific applications until 31 December 2004 and 31 December 2008
4(2)(i)	CA request to the Commission	Request for increased quantities of methyl bromide
4(2)(iii)	Member State to report to Commission	Methyl bromide quantity authorised for QPS use
4(4)(iv)	CA to report to Commission	Halon quantities used in critical uses, emission reduction measures, emission estimate, identification of alternatives
5(3)	Member State to report to Commission	Inform Commission if HCFC is to be used to replace halons in firefighting systems
5(7)	CA request to the Commission	Request for exemption for use and placing on market of HCFCs
6(1)	Commission to report to CA	Copies of import licences to be sent to CA
6(2)	CA to notify Commission	Approval of ODS used for inward processing relief
12(1)	Commission to report to CA	Copies of export licences to be sent to CA
12(4) from Reg. 1804 of 2003	CA to notify Commission	Verification of compliance with Article 11(1)(d) that halons exported for critical uses are stored in facilities operated or authorised by the CA
16(5)	Member State to report to Commission	Qualification requirements related to recovery of ODS
16(6)	Member State to report to Commission	Systems established to promote recovery of ODS
17(1)	Member State to report to Commission	Qualification requirements with regard to leak detection
19(1)	Producer, Importer, Exporter to report to Commission (and copy to CA)	Production, import and export data
19(2)	Customs Authorities to report to Commission	Send stamped used licence documents to Commission
19(3)	Essential users to report to Commission (and copy to CA)	Nature of use, quantities used, held in stock, recycled or destroyed, and quantity of products containing controlled substances placed on the EU market or exported
19(4)	Those authorised to use controlled substances as processing agents report to Commission	Quantities used and estimate of emissions
20(2)	Commission to report to CA	Copy of request for information from Commission to any undertaking to be sent to CA
20(3)	Member State to report to Commission	Schedules and results of random checks on imports of controlled substances
21	Member State to report to Commission	Report to Commission on penalties put in place in relation to breach of the Regulation

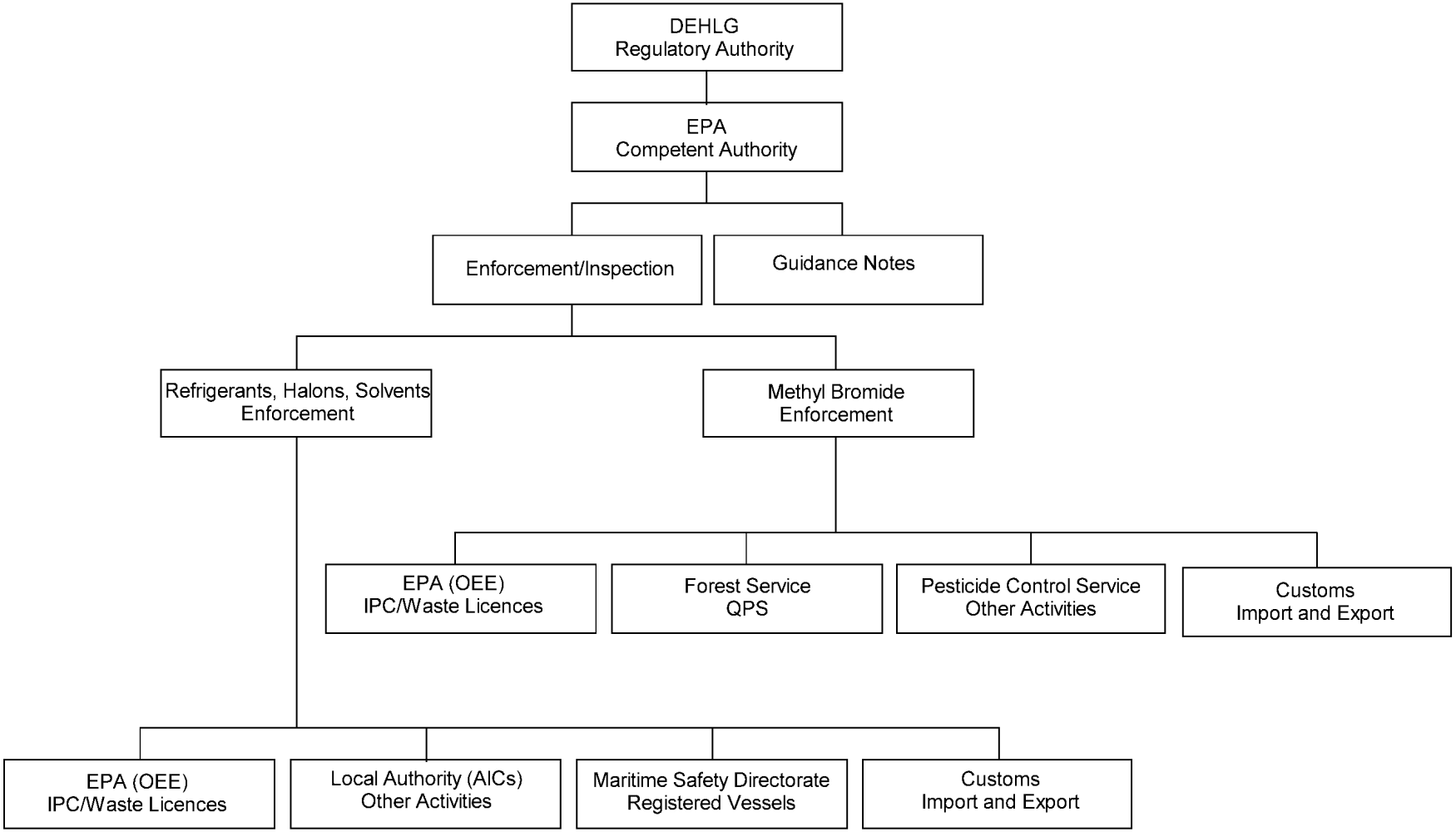

Figure 1. Proposed enforcement/inspection structure for implementation of Regulation 2037/2000.

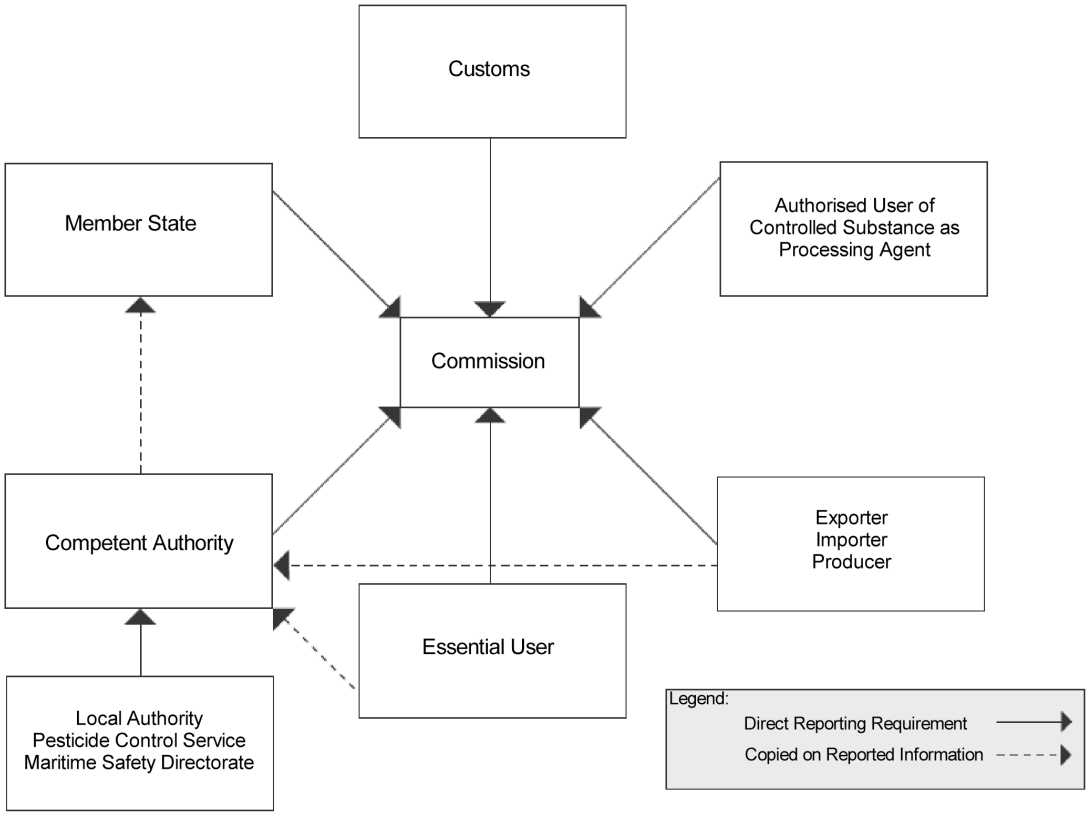

Figure 2. Proposed reporting structure for Regulation 2037/2000.

1 Introduction

1.1 Project Background

URS Ireland Ltd (URS) was commissioned by the Environmental Protection Agency (EPA) to undertake a study on the implementation of EC Regulation 2037/2000 on Substances that Deplete the Ozone Layer.

The aim of the study was to assess the measures required for Ireland to fully implement the requirements of Articles 16(5), 16(6), 17(1) and 17(2) of the Regulation.

1.2 Overview of the Relevant Articles

Article 16 refers to the actions required to ensure the appropriate management of ozone-depleting substances (ODS) (referred to under the Regulation as 'controlled substances') contained in:

- Refrigeration, air-conditioning and heat-pump equipment
- Equipment containing solvents
- Fire-protection systems and fire extinguishers.

The Regulation defines 'controlled substances' as follows:

'controlled substances' means chlorofluorocarbons, other fully halogenated chlorofluorocarbons, halons, carbon tetrachloride, 1,1,1-trichloroethane, methyl bromide, hydrobromofluorocarbons, hydrochlorofluorocarbons and bromochloromethane whether alone or in a mixture, and whether they are virgin, recovered, recycled or reclaimed. This definition shall not cover any controlled substance which is in a manufactured product other than a container used for the transportation or storage of that substance, or insignificant quantities of any controlled substance, originating from inadvertent or coincidental production during a manufacturing process, from unreacted feedstock, or from use as a processing agent which is present in chemical substances as trace impurities, or that is emitted during product manufacture or handling.

Article 16(5) specifically requires that Member States take steps to promote the recovery, recycling, reclamation and destruction of controlled substances, and assign to users, refrigeration technicians or other appropriate bodies responsibility for ensuring compliance with the provisions of Article 16(1)[1]. Article 16(5) also requires Member States to define the minimum qualification requirements for the personnel involved in the above processes and to report on programmes related to these by 31 December 2001.

Article 16(6) requires that Member States report to the Commission on the systems established to promote the recovery of used controlled substances, including the facilities available and the quantities of used controlled substances recovered, recycled, reclaimed or destroyed.

Article 17 refers to the measures required to prevent and minimise leakages of controlled substances.

Article 17(1) requires that all precautionary measures practicable be taken to prevent and minimise leakage of controlled substances. In particular, annual leakage checks are required for fixed equipment with a refrigerating fluid charge of more than 3 kg. Furthermore, this Article specifically requires Member States to define the minimum qualification requirements for the personnel involved and to report on programmes related to these qualification requirements by 31 December 2001.

Article 17(2) requires that all precautionary measures practicable be taken to prevent and minimise leakage of methyl bromide from fumigation installations and operations in which methyl bromide is used. Article 17(2) also requires that, whenever methyl bromide is used in soil fumigation, the use of virtually impermeable films for a sufficient time, or other techniques ensuring at least the same level of environmental protection, shall be mandatory. Member States shall also define the minimum qualification requirements for the personnel involved.

1. Article 16(1) provides that controlled substances contained in:
   – refrigeration, air-conditioning and heat-pump equipment, except domestic refrigerators and freezers,
   – equipment containing solvents,
   – fire-protection systems and fire extinguishers
   shall be recovered for destruction by technologies approved by the Parties or by any other environmentally acceptable destruction technology, or for recycling or reclamation during the servicing and maintenance of equipment or before the dismantling or disposal of equipment.

1.3 A Guide to this Document

This document is intended to provide an overview of the current level of use of a number of specific ODS in Ireland – as outlined in Articles 16 and 17 – and the measures being taken to comply with Regulation 2037/2000. The gap analysis addresses four broad categories of ODS use, namely refrigeration and air-conditioning, fire suppression, fumigation, and solvent usage.

Section 2 provides a brief summary of the nature of the ozone layer and the characteristics and use of ozone-depleting substances.

Section 3 provides a summary of the history of legislation regarding the protection of the ozone layer, from the original Vienna Convention in 1985 to the current EC Regulation 2037/2000.

Section 4 explores the use of ozone-depleting substances, particularly CFCs and HCFCs in refrigeration and air-conditioning equipment.

Section 5 explores the use of halons in fire-suppression systems.

Section 6 explores the use of methyl bromide in quarantine, pest control and fumigation applications.

Section 7 explores the use of ozone-depleting solvents used in cleaning.

Section 8 provides an outline implementation strategy.

Each gap analysis addresses the impact of the Regulation, the current baseline conditions in Ireland and the identified best practice measures for the following areas:

- The Regulatory Authority
- Import and Export
- Supply and Use
- Leak Detection
- Training and Certification
- Recovery, Recycling and Reclamation
- Disposal and Destruction.

A series of Guidance Notes covering the use and phase out of:

- CFCs and HCFCs in Refrigeration and Air-Conditioning Systems
- Halons in Fire-Suppression Systems
- Methyl Bromide in Pest Control and Fumigation
- Solvents in Cleaning Systems

is under development to accompany this gap analysis report.

It is important to note that the legislative references detailed in the text are subject to ongoing review both at EU and national level and may change in time, e.g. the Transfrontier Shipment of Waste Regulations are currently being revised. Likewise, due to the dynamic nature of technological developments and scientific progress, requirements in relation to issues such as recovery and available alternatives, etc., will change. UNEP, EU and national websites referenced should be consulted for the most up-to-date information.

The Meetings of the Parties (MOPs) to the Montreal Protocol take decisions in relation to amendments to the Protocol on the basis of new information and the ongoing work of the technical groups. As noted above, it is important that the reports of the MOPs (available on the UNEP website) are checked for any updates, e.g. Decision X/14 and Decision XV/6 of MOP-10 and MOP-15, respectively, amend Annex VI in relation to uses of controlled substances as process agents.

2 The Ozone Layer

2.1 What is Ozone?

Ozone is a gas composed of three bonded oxygen atoms (O_3). It is formed during high energy photochemical reactions from molecular oxygen. Ozone may be found in two distinct areas in the earth's atmosphere, namely at ground level and stratospheric. At ground level it is a significant component of photochemical smog; however, in the stratosphere, it is referred to as the *ozone layer*.

The ozone layer encircles the earth's upper atmosphere at approximately 10 km above ground level. It acts as a filter against ultraviolet (UV) radiation reducing the amount of radiation reaching earth, particularly the harmful UV-B radiation. If the ozone layer is depleted, the shielding capacity of the atmosphere is reduced, which can have far-reaching effects on the earth's ecosystem. Some examples of this may include:

- Increases in the occurrence of skin cancers, cataracts and weakened immune systems
- Changes in the chemical composition and quality of certain plant species
- Damage to aquatic organisms, leading to losses in fisheries
- Degradation of building materials, particularly paints, rubbers, woods and plastics.

In the 1970s, scientists discovered that the ozone concentration over Antarctica had diminished by up to 70%. This phenomenon was linked to the release of ozone-depleting substances into the stratosphere and was referred to as the *hole in the ozone layer*. Available stratospheric ozone monitoring data suggest that the ozone levels are still decreasing; however, the rate of decrease has declined since the implementation of the Montreal Protocol. Recent measurements in Antarctica (where the ozone hole was first discovered) indicate that the loading of ODS at the surface has now reduced by 6% from the peak levels measured in 1994. Whilst this is encouraging, the ozone layer itself has not yet shown any signs of recovering (though the rate of destruction of ozone has decreased) and it is estimated that it will be after 2050 before the hole in the ozone layer over Antarctica closes over completely. Therefore, the concerted efforts that have been made since the implementation of the Vienna Convention and the Montreal Protocol should continue to ensure recovery of the stratospheric ozone layer.

2.2 What are ODS?

Scientists have identified and continue to identify ODS. They fall into a series of distinct chemical classes and are generally chlorinated, fluorinated or brominated hydrocarbons. Each chemical class contains a number of individual chemical compounds.

The destructive lifetime of ODS may range from 100 to 400 years, depending on the compound. Therefore, one molecule of ODS has the potential to destroy hundreds of thousands of ozone molecules. The ability of a given compound to destroy ozone is referred to as its ozone-depletion potential (ODP). Table 2.1 provides a summary of the most common types of ODS and their relative ODPs. Each substance is assigned an ODP relative to the compound CFC-11, whose ODP is defined as '1'.

Table 2.1. ODS and ODP examples.

Chemical group	Specific examples	ODP
Chlorofluorocarbons (CFCs)	CFC-11/CFC-12	1.0/1.0
Hydrochlorofluorocarbons (HCFCs)	HCFC-22	0.055
Halons	Halon-1301	10.0
Hydrobromofluorocarbons (HBFCs)	HBFC-22B1	0.74
Bromochloromethane	–	0.12
Carbon tetrachloride	–	1.1
Methyl bromide	–	0.6

A list of the most common ODS compounds and the different names which may be employed for each substance are detailed in Table 2.2.

2.3 Common Uses of ODS

Table 2.3 provides a summary of the most common usages now subject to the requirements of the Protocol and EU Regulation.

ODS may be released to the atmosphere through their general use or through mishandling. The most common release pathways are:

- Venting/purging of refrigeration or air-conditioning systems during servicing
- Discharge of fire-suppression systems
- Use of aerosols
- Open-air use of cleaning solvents
- Residual gas after fumigation
- Incorrect disposal of ODS-containing equipment
- Leaking units.

Once released to the atmosphere, ODS may be carried on thermodynamic currents to the stratosphere where they will begin to react with and destroy ozone molecules. Due to their long lifespan, most ODS will reach the stratosphere at some point.

Table 2.2. Details of most commonly encountered ozone-depleting substances.

Trade name	ASHRAE* No.	ODS grouping	Scientific formula	Scientific name
CFC-11	R-11	CFC	CCl_3F	Trichlorofluoromethane
CFC-12	R-12	CFC	CCl_2F_2	Dichlorodifluoromethane
CFC-113	R-113	CFC	$C_2F_3Cl_3$	1,1,2-Trichlorotetrafluoroethane
CFC-114	R-114	CFC	$C_2F_4Cl_2$	Dichlorotetrafluoroethane
CFC-115	R-115	CFC	C_2F_5Cl	Monochloropentafluoroethane
Halon-1211	R-12B1	Halon	CF_2ClBr	Bromochlorodifluoromethane
Halon-1301	R-13B1	Halon	$CBrF_3$	Bromotrifluoromethane
Halon-2402	R-114B2	Halon	$C_2F_4Br_2$	Dibromotetrafluoroethane
CFC-13	R-13	CFC	CF_3Cl	Chlorotrifluoromethane
CFC-111	R-111	CFC	C_2FCl_5	Pentachlorofluoroethane
CFC-112	R-112	CFC	$C_2F_2Cl_4$	Tetrachlorodifluoroethane
CFC-211		CFC	C_3FCl_7	Heptachlorofluoropropane
CFC-212		CFC	$C_3F_2Cl_6$	Hexachlorodifluoropropane
CFC-213		CFC	$C_3F_3Cl_5$	Pentachlorotrifluoropropane
CFC-214		CFC	$C_3F_4Cl_4$	Trichlorotetrafluoropropane
CFC-215		CFC	$C_3F_5Cl_3$	Trichloropentafluoropropane
CFC-216		CFC	$C_3F_6Cl_2$	Dichlorohexafluoropropane
CFC-217		CFC	C_3F_7Cl	Chloroheptafluoropropane
Carbon tetrachloride	R-10	Carbon tetrachloride	CCl_4	Tetrachloromethane
Methyl chloroform	R-140a	Methyl chloroform	$C_2H_3Cl_3$	1,1,1-Trichloroethane
Methyl bromide		Methyl bromide	CH_3Br	Bromomethane
HCFC-22	R-22	HCFC	$CHClF_2$	Chlorodifluromethane
HCFC-123	R-123	HCFC	$CHCl_2CF_3$	Dichlorotrifluoroethane
R-401a	R-401a	HCFC	R-22/152a/124	
R-500	R-500	CFC	R-12/152a	
R-502	R-502	CFC	R-22/115	

*ASHRAE, American Society for Heating, Refrigeration and Air-Conditioning Engineers.

Table 2.3. Summary of ODS use (primarily historical use).

Use	Description
Refrigerants	Domestic refrigerators typically contained CFC-12 as the refrigerant gas. Commercial systems tended to use CFC-12, HCFC-22 or R-502 (a blend of both). Transport refrigeration units have typically used CFC-11, CFC-12, CFC-114, HCFC-22 or the blends R-500 and R-502
Air conditioning	Older domestic and commercial air-conditioning and heat-pump systems may contain HCFC-22, CFC-11, CFC-12 or CFC-114. The air conditioning in older vehicles may contain CFC-12
Blowing agents	CFC-11 was historically used as a foam-blowing agent in the manufacture of polyurethane, phenolic, polystyrene and polyolefin foams and plastics
Cleaning solvents	CFC-113 was widely used as a cleaning agent in the electronics industry, as well as in other high precision cleaning and metal degreasing processes
Propellants	CFC-11 and CFC-12 were widely used as aerosol propellants in paints, deodorants, perfumes, insecticides, pharmaceuticals, glues, oils and cleaners. CFC-114 was used specifically to dispense products containing alcohol and CFC-113 was used to dispense cleaning agents
Sterilising agent	CFC-12 (mixed with ethylene oxide) was used for medical device sterilisation
Fumigants	Methyl bromide is a broad-spectrum pesticide agent
Feed stock	HCFCs and carbon tetrachloride are used as feedstock in a variety of chemical processes
Fire suppression	Halons and HBFCs were widely used as fire-suppression agents both in hand-held extinguishers and flooding systems

3 Legislative Overview

The Vienna Convention (1985) was held under the auspices of the United Nations Environment Programme (UNEP) and was the first attempt to provide a framework for countries to undertake co-operative activities to protect the ozone layer. The Convention was initially signed by 21 Member States, including the European Union. The Convention placed a responsibility on the signatory members to develop a protocol that would include specific control measures to protect the ozone layer.

The next major initiative came through the Montreal Protocol (1987) on *Substances That Deplete the Ozone Layer.* The Protocol was signed by 24 countries and came into effect on 1 January 1989. The Protocol was ratified by Ireland on 16 December 1988. Parties to the Protocol agreed to freeze their production and consumption of eight specified ozone-depleting substances within 7 months and to reduce consumption of CFCs by 50% within 10 years. Since then, over 175 countries have ratified the Montreal Protocol. In the dynamic history of the Protocol, there have been four amendments and five adjustments. Table 3.1 provides a summary of the key changes.

Under the Protocol, each signatory country is listed in either Article 5 (developing countries) or Article 2 (developed countries). Differing phase-out schedules have been established for Article 5 and Article 2 countries in acknowledgement that developing countries have less access to the new technologies, skills and funds necessary to replace existing ODS systems. Ireland is listed as an Article 2 country and is not subject to any leniency in complying with the phase-out schedule.

In Europe, the requirements of the Montreal Protocol were initially implemented through Regulation 3322/88 on *Certain Chlorofluorocarbons and Halons that Deplete the Ozone Layer*. This was superseded by EC Regulation

Table 3.1. Amendments to the Montreal Protocol.

Title	Key changes
1990	
2nd Meeting of the Parties (London Amendment entered into force on 10 August 1992)	1 Introduced additional CFCs, carbon tetrachloride and methyl chloroform as controlled substances 2 Adopted control measures for the new substances 3 Accelerated the phase-out schedules for CFCs and halons
1992	
4th Meeting of the Parties (Copenhagen Amendment entered into force on 14 June 1994)	1 Introduced the Multilateral Fund to assist developing countries implement the Protocol 2 Introduced methyl bromide, HBFCs and HCFCs as controlled substances 3 Accelerated the phase-out schedules for CFCs, halons, carbon tetrachloride and methyl bromide 4 Established provisions for the production and consumption of essential uses of ODS
1995	
7th Meeting of the Parties	1 Introduced control measures for methyl bromide 2 Introduced controls on HCFC and HBFC production and consumption 3 Addressed problems of non-compliance
1997	
9th Meeting of the Parties (Montreal Amendment entered into force on 10 November 1999)	1 Additional control measures for methyl bromide 2 Requirement to establish import/export licensing system for all ODS
1999	
11th Meeting of the Parties (Beijing Amendment entered into force on 25 February 2002)	1 Introduced bromochloromethane as a controlled substance 2 Additional controls on bromochloromethane and HCFCs 3 Requirement to report on methyl bromide use for quarantine and preshipment use

3093/94, which incorporated the early amendments to the Montreal Protocol. EC Regulation 2037/2000 was introduced in 2000, again in response to the tighter restrictions introduced through the amendment of the Montreal Protocol. Further minor amendments have followed and a brief summary is provided as follows:

- EC Regulation 2038/2000 of the European Parliament and of the Council of 28 September 2000 Amending EC Regulation 2037/2000 on substances that deplete the ozone layer, as regards to metered dose inhalers and medical drug pumps

- EC Regulation 2039/2000 of the European Parliament and of the Council of 28 September 2000 Amending EC Regulation 2037/2000 on substances that deplete the ozone layer, as regards the base year for the allocation of quotas of hydrochloro-fluorocarbons

- EC Regulation 1804/2003 of the European Parliament and of the Council of 22 September 2003 Amending EC Regulation 2037/2000 as regards the control of halon exported for critical uses, the export of products and equipment containing chloro-fluorocarbons and controls on bromochloromethane

- Commission Decision of 3 March 2004 amending EC Regulation 2037/2000 of the European Parliament and of the Council with regard to the use of Halon-2402

- Commission Decision of 12 August 2002 determining a mechanism for the allocation of quotas to producers and importers for hydrochlorofluorocarbons for the years 2003 to 2009 under EC Regulation 2037/2000 of the European Parliament and of the Council

- Commission Decision of 7 March 2003 amending EC Regulation 2037/2000 of the European Parliament and of the Council with regard to the use of Halon-1301 and Halon-1211.

A number of other Commission Decisions have been issued with regard to annual allocations of import quotas for controlled substances and the quantities of controlled substances allowed for essential uses. These can be found on the internet at
http://europa.eu.int/comm/environment/ods/home/home.cfm

As the legislation was promulgated in the form of a Regulation (rather than a Directive) it is directly enforceable and binding in Ireland on all persons involved in production, importation, exportation, placing on the market, use, recovery, recycling, reclamation and destruction of controlled substances defined under the Regulation. A summary of Regulation 2037/2000, as it specifically relates to each of the four main categories of ODS use, is included at the start of each section.

4 Gap Analysis for CFCs and HCFCs

4.1 Information on Refrigerants

The majority of the substances controlled under EC Regulation 2037/2000 have been commonly used as refrigerants in industrial, commercial and domestic equipment. These substances are typically referred to by their acronyms CFC (chlorofluorocarbon) and HCFC (hydrochlorofluorocarbon). Table 4.1 provides an overview of the most commonly used compounds covered by the Regulation.

In general, CFCs and HCFCs are non-flammable, non-corrosive and are compatible with most materials. In addition, their thermodynamic and physical properties make them ideal for a variety of uses, particularly as coolants in refrigeration systems and air-conditioning systems.

CFCs and HCFCs have also found use in the manufacture of aerosol sprays, as blowing agents for foams in insulation boards, panels and pipe covers, as packing materials and as solvents. This gap analysis focuses on their dominant area of use in Ireland, namely as refrigerants in refrigeration and air-conditioning systems. Their use as solvents is covered in Section 7.

General Motors first synthesised CFCs in 1928. By 1935, 8 million refrigerators, which contained CFC-12, had been sold in the United States alone. In 1932, the Carrier Engineering Corporation used CFC-11 in the world's first self-contained home air-conditioning unit. After World War II, CFCs were used as propellants for sprays, paints, hair conditioners, and other health-care products. During the late 1950s and early 1960s, CFCs were utilised in air conditioning in many cars, homes, and office buildings. Data on historical usage of CFCs and HCFCs (UNEP) indicate that typical production and sales worldwide can be split into 40% HCFC-22, 25% HCFC-134a, 23% HCFC-141b, 3.8% CFC-12 and 1.5% CFC-11 (based on 2001 data).

Table 4.2 provides a summary of the most common CFC and HCFC applications.

Discussions with industry contacts indicate that the main refrigerants used in Ireland were CFC-12 (pre-1994) and HCFC-22 (post-1994). It is reported that CFC and HCFC cooling systems were commonly used in:

- Non-confined direct evaporation systems
- Domestic and commercial refrigerators and freezers
- Insulated sandwich panels used to construct cold rooms or chill rooms
- Air conditioning in motor vehicles, tractors and off-road vehicles
- Trailer air-conditioning systems
- Public-transport air conditioning (road and rail)

Table 4.1. CFCs and HCFCs.

Halocarbon number	Molecular formula	Name	ODP
CFC-11	CCl_3F	Trichlorofluoromethane	1.0
CFC-12	CCl_2F_2	Dichlorodifluoromethane	1.0
CFC-113	$C_2Cl_3F_3$	Trichlorotrifluoroethane	0.8
CFC-114	$C_2Cl_2F_4$	Dichlorotetrafluoroethane	1.0
CFC-115	C_2ClF_5	Chloropentafluoroethane	0.6
CFC-502	Blend of HCFC-22 and CFC-115		0.221
CFC-13	$CClF_3$	Chlorotrifluoromethane	1.0
HCFC-141b	CH_3CFCl_2	HCFC blend	0.110
HCFC-22	CHF_2Cl	Chlorodifluoromethane	0.055

Note: A large number of other compounds exist which are used less frequently, including many HCFC blends such as HCFC-401a and HCFC-123. It should also be noted that the CFC or HCFC prefix is often replaced with the letter 'R'.

Table 4.2. Summary of CFC and HCFC applications.

Compound	Application
CFC-12	Used for a wide variety of refrigeration and air-conditioning applications. Almost all refrigerators and freezers built before 1994 used CFC-12 and many are still in use. CFC-12 was also used in other small hermetic systems such as retail display cases, icemakers, etc. It was used in medium- and large-sized systems in commercial and industrial refrigeration and in automobile air-conditioning systems. CFC-12 was almost universally replaced in automobiles with HFC-134a in 1993–1996. R-401a (a mixture of HCFC-22, HCFC-124 and HCFC-152a) and R-409a (a mixture of HCFC-22, HCFC-124 and HCFC-142b) are typically used as replacement gases for other uses of CFC-12
CFC-11	Used in insulating foam pre-1990. It has been used in large chillers for air-conditioning and industrial applications. It was eliminated from use in the foam in seats, bumpers and steering wheels of motorised vehicles in 1993
HCFC-141b	Used in insulating foam post-1994, before its elimination in January 2003. It was the predominant refrigerant/blowing agent in domestic refrigeration systems
HCFC-22	Has been widely used in commercial, industrial and air-conditioning systems. It was used in many applications that could not be manufactured using CFCs. It is also the most likely refrigerant to have been be used in the air-conditioning and heat-pump applications
CFC-502	Usually used in low-temperature commercial and small industrial cooling installations (e.g. supermarket frozen food systems, small cold stores and small blast freezers). CFC-502 quickly became scarce after the 1995 phase out of CFC production and it is believed that there are relatively few CFC-502 systems still in use
HCFC-123	Is a relatively unusual refrigerant. It was introduced as an alternative for CFC-11, before being banned itself, in large air-conditioning water chillers following CFC production phase out
Other CFCs	The remaining CFCs were used for less common applications. CFC-13 and CFC-503 were used in very low-temperature cascade systems (e.g. at below –70°C). CFC-114 and CFC-500 were occasionally used in large water chillers. CFC-115 was rarely used by itself – it is one of the fluids used in the refrigerant mixture CFC-502

- Fishing trawlers
- Public and distribution cold stores and warehouses
- Equipment of 150 kW and over shaft input.

Table 4.3 lists the most common trade names for CFCs and HCFCs used as refrigerants. The use of the trade names is not standardised; for example, the term ‘Forane’ is used to describe CFCs and HCFCs.

Table 4.3. CFC and HCFC refrigerant trade names.

Refrigerant trade names ©
Arcton, Care, Freon, Forane, Genetron, Greencool, Isceon, Klea, Solkane, Suva

4.2 Impact of EC Regulation 2037/2000

4.2.1 The Regulatory Authority

The Department of the Environment, Heritage and Local Government (DEHLG) is the Regulatory Authority in Ireland for this Regulation. The Competent Authority (or authorities) for the implementation of the Regulation has not yet been designated in Ireland. The Member States’ responsibilities under the Regulation include:

- Provision of information to the Commission on the requirements for the production, import or use of HCFCs for nominated critical uses
- Encourage the development and use of CFC and HCFC alternatives and promote the recovery, recycling, reclamation and destruction of ODS
- Define the minimum qualification requirements for personnel involved in refrigerant handling and leakage checking
- Report to the Commission by 31 December 2001 on the programmes implemented to achieve the specified minimum qualification requirements and annually on the systems established to promote the recovery of used controlled substances.

4.2.2 Imports and exports

It is noted that the Regulation defines the terms ‘imports’ and ‘exports’ as the transport of goods across EU, rather than national boundaries. Articles 6–15 of the Regulation address trade issues.

The Regulation does not include any specific requirements in relation to the import or export of CFCs or HCFCs into Ireland from within the EU. The transport of CFCs/HCFCs as waste products is covered under other pre-existing national and EU legislation including:

- *Waste Management (Hazardous Waste) Regulations, 1998*

- *Waste Management (Movement of Hazardous Waste) Regulations, 1998*
- *Waste Management (Transfrontier Shipment of Waste) Regulations, 1998*
- *The Carriage of Dangerous Goods by Road Regulations, 2001*
- *The European Communities (Safety Advisers for Transport of Dangerous Goods by Road and Rail Regulations), 2001*
- *Transportable Pressure Equipment Directive, 1999/36/EC.*

All relevant legislation must be considered when transporting waste ODS.

Import of CFCs is prohibited. Exceptions to these conditions include controlled substances used for essential uses (e.g. laboratory use, medical use), used for feedstock or as a processing agent, or imported for destruction. Regulation 2037/2000 states that controlled substances listed in Groups I, II, III, IV and V (as listed in Annex I of the Regulation) should not be imported for inward processing. CFCs are included in Groups I and II. The release for free circulation or inward processing of controlled substances from any State not party to the Montreal Protocol is prohibited.

The import into the EU of refrigeration equipment containing CFC refrigerants is prohibited unless the equipment was manufactured before 30 September 2000.

As detailed in Article 11(1), export of CFCs from the Community is banned with a small number of exceptions as reported in Article 11(1).

Import of HCFCs requires an import licence as issued by the Commission, and is subject to strict quantitative limits as defined in the Regulation.

Products and equipment containing HCFCs can be imported until the relevant use control dates (as detailed in Article 5(1)) take effect. After those dates, the import of products and equipment containing HCFCs is prohibited, unless the products were manufactured before the control date. Exports of products and equipment containing HCFCs to States party to the Montreal Protocol where the use of HCFCs is still permitted can continue until 31 December 2009.

The export of HCFCs to countries not party to the Montreal Protocol was prohibited from 1 January 2004. The Beijing Amendment to the Montreal Protocol also bans the import and export of HCFCs between countries who have not ratified the Copenhagen Amendment (which was agreed in 1992).

Exporters of ODS require an export authorisation from the Commission for all exports.

Information on how to apply for an allocation for import, essential laboratory uses, and export and forms for reporting on import and export statistics are available on the Commission ODS website at:
http://europa.eu.int/comm/environment/ods/home/home.cfm

4.2.3 Supply and use

Two types of users are identified under the Regulation:

1. *Non-critical users* which operate specified processes or applications for which viable alternatives are available
2. *Critical users* which operate specified processes or applications where alternatives have yet to be developed and implemented.

It should also be noted that Article 5(3) of the Regulation allows the use of HCFCs as fire-fighting agents in existing fire-protection systems for the replacement of halons in applications listed in Annex VII of the Regulation, subject to certain conditions.

The impact of the Regulation on each of these use types is discussed below.

4.2.3.1 Non-critical users

The following applies for all non-critical uses of CFCs and HCFCs:

- The supply of CFCs was banned from 1 October 2000
- The use of CFCs in the maintenance of refrigeration equipment was banned from 1 January 2001
- The use of HCFCs in the manufacture of all new refrigeration and air-conditioning equipment is now banned. The Beijing Amendment to the Montreal Protocol also bans the import and export of HCFCs between countries who have not ratified the Copenhagen Amendment (which was agreed in 1992)

- There will be a ban imposed from 1 January 2010 for the use of virgin HCFCs in the maintenance of refrigeration and air-conditioning units
- There will be a ban on the use of all HCFCs from 1 January 2015
- The refurbishment or upgrade of existing installations or systems currently using HCFC refrigerants, which would result in an increase in the refrigerant volume is prohibited
- HCFCs that are used in products that are intended for export to countries where the use of HCFC is still allowed, is permitted until 31 December 2009.

Figures 4.1 and 4.2 provide a summary of the phase-out dates for HCFCs used in refrigeration and in foams, respectively.

4.2.3.2 Critical users

Article (4)(4)(i)(b) of the Regulation indicates the circumstances under which the prohibition on the use and placing on the market of CFCs does not apply. These include:

- Placing on the market for destruction
- If the controlled substances are used for feedstock or as a processing agent
- If the controlled substances are employed in licensed essential uses or critical uses
- If the controlled substances are contained in products or equipment manufactured before the entry into force of the Regulation.

Article 5 of the Regulation indicates that the use of HCFCs is prohibited in aerosols, as solvents, as refrigerants, for the production of foams, as a carrier gas for sterilisation substances in closed systems (in equipment produced after 31 December 1997) and in all other applications. The following exemptions apply:

- Use as a solvent is allowed for the precision cleaning of electrical and other components in aerospace and

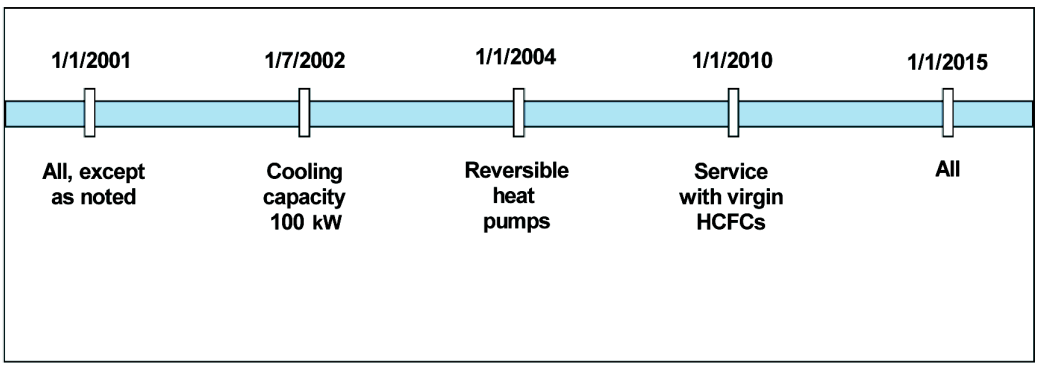

Figure 4.1. HCFC bans – refrigeration.

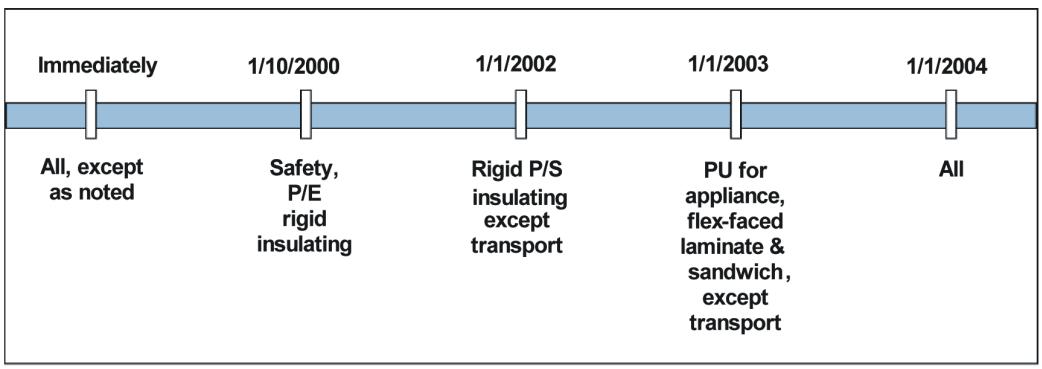

Figure 4.2. HCFC bans – foam.

aeronautics applications where the prohibition shall enter into force on 31 December 2008

- Use as a refrigerant is allowed in equipment produced for vehicles in military uses where the prohibition shall enter into force on 31 December 2008
- The use of virgin HCFCs is allowed in the maintenance and servicing of refrigeration and air-conditioning equipment until 31 December 2009. Recovered HCFCs may be employed until 31 December 2014
- Laboratory uses, including research and development
- Use as a feedstock
- Use as a processing agent
- Use as fire-fighting agents in existing fire-protection systems for replacing halons in applications listed in Annex VII (subject to conditions)
- Importation and placing on the market of products and equipment containing HCFCs are allowed, provided the product or equipment was manufactured prior to the date of any use restriction for that purpose
- Until 31 December 2009, the use of HCFCs for the production of products for export to countries where the use of HCFCs in those products is still permitted.

As detailed in Article 3(1) of the Regulation, any essential users of CFCs must make a declaration to the Commission copying the Competent Authority of the Member State for authorisation for this use. A declaration for essential use for CFCs (e.g. use in metered dose inhalers or for laboratory use or import for use as a feedstock) should be made to the Commission, usually by August of the preceding year. Guidelines for making a declaration for an essential use to the Commission are available on the ODS website (http://europa.eu.int/comm/environment/ods/home/home.cfm). The Commission shall notify them of the use for which they have authorisation and the substances and quantities thereof that they are authorised to use. A new application must be made each year.

Article 5(7) also includes a derogation provision for the Commission to authorise time-limited exemptions to allow the use and placing on the market of HCFCs in certain circumstances.

Producers, importers and exporters have annual reporting obligations under Article 19(1). In addition, under Article 19(3) of the Regulation, essential users are also obliged to report to the Commission annually with the following information (a copy should also be sent to the Member State Competent Authority):

- The nature of the use
- The quantities used during the previous year
- The quantities held in stock
- Any quantities recycled or destroyed
- The quantity of products containing those substances placed on the Community market and/or exported.

Article 19(4) requires that each undertaking which has been authorised to use controlled substances as a processing agent shall report to the Commission (and also send a copy to the Competent Authority) the quantities used during the previous year, and an estimate of the emissions which occurred during such use.

It is important to note that essential uses are reviewed annually by the Commission who may decide to no longer allow an essential use if viable alternatives are available.

4.2.4 Training and certification

The Regulation requires that Member States define the minimum qualification requirements for personnel involved in recovery, recycling, reclamation or destruction of CFCs and HCFCs. Each Member State was required to report to the Commission by 31 December 2001 on the programmes implemented relevant to the qualification requirements.

4.2.5 Leak detection

The Regulation requires that all precautionary measures practicable be taken to prevent and minimise leaks of controlled substances. In particular, fixed equipment with a refrigerating fluid charge of more than 3 kg must be checked for leaks annually. This also applies where controlled substances are used as a feedstock or as processing agents, or where CFCs or HCFCs are produced as intermediates in the course of manufacture of other chemicals.

The Regulation required that the Commission prepare European Standards relating to the control of leakages and to the recovery of substances from commercial and industrial air-conditioning and refrigeration equipment. In 2000, the European Standard EN 378 (*Refrigerating Systems & Heat Pumps – Safety & Environmental Requirements*) was published**.** This Standard has replaced all national standards and compliance with the Standard should satisfy the requirements of the Regulation 2037/2000 for leak detection.

Another draft Regulation from the European Commission linked to climate change was issued in 2003. *Proposal for a Regulation of the European Parliament and of the Council on Certain Fluorinated Greenhouse Gases* (COM(2003) 492 Final) proposes that systems containing more than 300 kg of hydrofluorocarbon (HFC) refrigerant install leak-detection systems.

4.2.6 Recovery, recycling and reclamation

The Regulation requires that all ODS in refrigeration and air-conditioning units must be recovered during servicing, maintenance or disposal of equipment.

Regulation 2037/2000 defines recovery, recycling and reclamation as follows:

- *Recovery* is the collection and the storage of controlled substances from, for example, machinery, equipment and containment vessels during servicing or before disposal
- *Recycling* is 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
- *Reclamation* is the reprocessing and upgrading of a recovered controlled substance through such processes as filtering, drying, distillation and chemical treatment in order to restore the substance to a specified standard of performance, which often involves processing off-site at a central facility.

4.2.7 Disposal and destruction

The restrictions placed on the import and export of controlled substances do not apply where these substances are being transported within the Community for destruction by approved parties (Article 4(4)(i)(a)).

Transport and disposal must comply with all relevant national and EU legislation pertaining to the disposal of hazardous waste. This includes:

- *Waste Management (Hazardous Waste) Regulations, 1998*
- *Waste Management (Movement of Hazardous Waste) Regulations, 1998*
- *Waste Management (Transfrontier Shipment of Waste) Regulations, 1998*
- *The Carriage of Dangerous Goods by Road Regulations, 2001*
- *The European Communities (Safety Advisers for Transport of Dangerous Goods by Road and Rail Regulations), 2001*
- *Transportable Pressure Equipment Directive, 1999/36/EC.*

4.3 Baseline Analysis

Contact was made with a number of companies involved in CFC and HCFC management in Ireland including:

- Refrigerant and air-conditioning users (critical and non-critical)
- Maintenance and service companies who install and decommission systems
- Waste brokers involved in exporting waste for disposal
- Training and advisory bodies.

The survey contact list is included in Appendix A.

4.3.1 Imports and exports

Once a year, notices are published in the Official Journal of the European Union (notice to Exporters, notice to Importers, notice to users of controlled substances for essential uses in the Community). The requirements of EC Regulation 2037/2000 amended by EC Regulation 1804/2003 are detailed in these documents. Importers and essential users can only apply once a year, after publication of the notices in the OJEC. Exporters can apply throughout the year. A company that wants to use ODS must consult the appropriate notices and then transmit the required information to the Commission. The Commission can assist the company to make its intended

declaration on a website (guide available on the ODS homepage) and to make electronic requests for import licences, authorisation of production, or export numbers.

For example, a company in Ireland has received a CFC quota from the Commission to use CFCs in Metered Dose Inhalers (MDIs). As part of the authorisation application process the Commission may also grant authorisation to export products (i.e. to countries outside the EU) and provide the company with an Export Authorisation Number (EAN). Article 2 of Commission Decision C(2004)103 of 28 January 2004 prohibits the placing of CFC-MDIs on markets that have deemed CFCs for these products to be non-essential as listed in Annex I of the Decision.

4.3.2 Supply and use

Only one Irish company is currently licensed by the Commission for the use of CFCs. This licence is for the use of CFCs in the production of MDIs for the treatment of asthma and other chronic obstructive pulmonary diseases.

Contact made with industry as part of this study indicated that refrigeration and air-conditioning systems that contain ODS are still in use. Whilst those systems containing HCFCs can continue in operation, sources estimate that between 5 and 10% of all refrigeration and air-conditioning units in Ireland still contain CFC-12. All ozone-depleting substances in refrigeration and air-conditioning units must be recovered during servicing/ maintenance and disposal of equipment; however, this does not reflect the current practice in Ireland. Refrigeration and air-conditioning systems containing R-12 are frequently topped up with R-404a (this is a blend of HFC-125, HFC-143a and HFC-134a, which has no ozone-depleting potential but does have a global-warming potential) and R-134a (this compound (1,1,1,2-tetrafluoroethane) is a HFC with no ozone-depleting properties, though it does have a global-warming potential). However, under the requirements of the Regulation the R-12 should be recovered from these systems during service/maintenance prior to input of any new refrigerant.

Any critical users must maintain detailed records of ODS usage (e.g. source, supply, quantities, type, where used, leakages, accidental discharges), as this will be requested by the Competent Authority.

Article 5(1)(d)(v) in EC Regulation 2037/2000 banned the use of HCFCs in the production of all types of foam including polyurethane spray and block foams from 1 January 2004.

It should also be noted that Article 5(3) of the Regulation allows the use of HCFCs as fire-fighting agents in existing fire-protection systems for the purposes of replacing halons in applications listed in Annex VII under the following conditions:

- Halons contained in such fire-protection systems shall be replaced completely
- Halons withdrawn shall be destroyed
- 70% of the destruction costs shall be covered by the supplier of the HCFCs
- Each year, Member States making use of this provision shall notify the Commission of the number of installations and the quantities of halons concerned.

There are no known operators making use of this provision, hence the Commission has not been notified of any such installations.

4.3.3 Training and certification

Qualification requirements have not yet been defined in Ireland for technicians working with refrigeration and air-conditioning systems. However, there are a number of industry-recognised training courses available in Ireland. Contact with a number of facilities involved in the manufacture and maintenance of air-conditioning and refrigeration systems in Ireland indicated that technicians have typically completed the FÁS (Training and Employment Authority) state-run apprenticeship programmes for refrigeration craft persons. The apprenticeship scheme is ‘Standards-Based’ and takes 4 years to complete. The scheme provides alternating phases of on-the-job training in FÁS Training Centres and Educational Colleges. On successful completion of the Apprenticeship, apprentices receive a National Craft Certificate, recognised in Ireland as well as in other EU and non-EU countries. The scheme does not include detailed information on the environmental aspects of refrigerant handling/service/maintenance. Additional modules should be introduced to the course to improve technicians’ knowledge in these areas.

The larger manufactures also run specialist in-house training programmes, but there is no external verification of the adequacy of these qualifications. Thermo King run an on-line version of the CERTI-TECH service technician certification programme. This programme is primarily intended to enhance the standard of technician training.

In 1999, a number of companies in the refrigeration/engineering sector formed a limited company (Refrigeration Technology Skillnet) to address their common commitment to improving training in Ireland. The company is operated under the directorship of a voluntary Board which contains nine representatives from the sector. Applied Technology Services (an industry centre within Dublin Institute of Technology) manages the network on behalf of the Board. Between May 2000 and December 2002, 40 events were held at which over 120 companies attended and over 700 personnel attended training courses. Some of these events have included presentations and workshops on Regulation 2037/2000 and the impacts of the Regulation on the refrigeration industry.

The Board aims to increase the quantity and quality of refrigeration technology training providers in Ireland and to establish course development partnerships with the state and commercial training providers in order to provide relevant, affordable and accredited training. Table 4.4 provides a summary of the training courses listed for 2003–2004. Again, increased coverage of environmental topics should be included as part of these courses.

4.3.4 Leak detection

Information gathered by URS during this study indicates that leak detection is not carried out regularly on refrigeration equipment in Ireland. In Ireland, the overall level of awareness of EN 378 (*Refrigerating Systems & Heat Pumps – Safety & Environmental Requirements*) is quite low. Only the larger operators (20–30 out of a total of around 400 companies) reportedly have possession of the Standard. The Standard has reportedly largely been ignored in Ireland due to perceived lack of enforcement.

Leak detectors do not come as standard in new refrigeration systems installed in Ireland and it is estimated that <1% of the end-users in Ireland have detection systems installed. The addition of a leak detector adds approximately 10% to the overall cost of the unit. Contact with refrigerant companies as part of this study indicated that plant operators find it easier to top up leaking systems with refrigerant, rather than find and repair leaks.

4.3.5 Recovery, recycling and reclamation

Contact with a number of service and maintenance contractors in Ireland would suggest that it is quite common in Ireland for refrigerant gases, which contain HCFCs, to be recovered from redundant units, cleaned and re-used in other units. All this work is carried out by the contractors themselves. Parts are also removed for spares before the units are dismantled.

Refrigeration and air-conditioning systems containing CFC-12 are frequently topped up with HFC-404a and HFC-134a. However, under the requirements of the Regulation the R-12 should be recovered from these systems during service/maintenance prior to input of any new refrigerant.

Where it is intended to sell second-hand units containing R-12, the refrigerant is replaced and the units are then placed on the second-hand market.

In terms of the quantities of refrigeration systems which will require recovery of ODS refrigerants before disposal, a number of important issues need to be considered when disposing of such systems:

- It is highly likely that any fridges manufactured prior to 1994 used CFCs as both refrigerants and as foam-blowing agents; hence, recovery of ODS materials will be required

Table 4.4. Available training courses.

General technical training	Specialised technical training
Introduction to refrigeration	Electronics & controls
Introduction to air-conditioning	Computers in refrigeration
Troubleshooting refrigeration systems	Industrial refrigeration
Troubleshooting air-conditioning systems	Vehicle air-conditioning
General methods of faultfinding	Refrigeration systems design
Intermediate refrigeration	Air-conditioning systems design
Intermediate air-conditioning	

- After 1994, these systems were replaced mainly with HFC refrigerant-based units; however, HCFC foam-blowing agents continued to be used; hence, recovery of ODS materials will be required

- Currently manufactured fridges typically use HFC or hydrocarbon refrigerants and hydrocarbon foam-blowing agents; hence, no ODS materials are included in these systems.

4.3.6 Disposal and destruction

All transfrontier shipments of waste should be accompanied by the required TFS (Transfrontier Shipment) documentation under the Waste Management (Transfrontier Shipment of Waste) Regulations, 1998. This documentation is forwarded to the relevant Local Authority. The Local Authority then forwards summary information from this document to the EPA in the format specified by the Agency for the purpose of maintaining national statistics on the export of waste.

Regulation 2037/2000 requires the removal of controlled substances from refrigeration equipment before an appliance is disposed off. This requirement came into force immediately for industrial and commercial appliances and has applied to domestic appliances since 1 January 2002. The Regulation covers fridges and freezers, which contain CFCs or HCFCs (either in the refrigerant or the insulating foam). The dismantling of refrigeration units and recovery of the ODS material is considered a prescribed activity. The Fourth Schedule to the Protection of the Environment Act 2003 defines waste recovery activities that require a Waste Licence (as issued by the EPA). Reclamation and recycling of CFC and HCFC refrigerants would be covered under Activity 2: Recycling or reclamation of organic substances which are not used as solvents and would therefore require a Waste License as issued by the EPA under the *Waste Management (Licensing) Regulations, 2000* (as amended).

Contact with a number of waste brokers in Ireland indicated that CFCs (CFC-12 in particular) collected from commercial units have been exported from Ireland for disposal in the UK and Germany. Waste brokers will arrange shipment and disposal of CFCs, including preparation of associated paperwork as required under national and EC legislation.

In response to the Regulation, the DEHLG and the Department of the Environment in Northern Ireland under the auspices of the North South Ministerial Council sought tenders for the operation of an all-island scheme for the management of waste domestic fridges and freezers.

The contract, which will terminate in August 2005, was awarded to M Baker Recycling Ltd to collect, transport, store and treat waste domestic refrigerators and freezers, and to manage the subsequent destruction of the recovered ODS and the possible recycling of the remaining constituent parts.

Funding for the management of waste domestic fridges and freezers in the Republic of Ireland is provided from the Environment Fund. However, in order to qualify for funding, Local Authorities must ensure free access for members of the public to civic amenity sites for receipt of the waste domestic fridges and freezers. Local Authorities in the Republic are also obliged to promote the availability of the service and give consideration to the provision of a kerbside collection service. There are currently 45 facilities operated by the Local Authorities which provide designated drop-off points for fridges and freezers.

The waste domestic fridges and freezers are transported to Baker's fridge recycling plant in St Helens, Merseyside in the UK. The recycling plant was licensed to operate by the Environment Agency in January 2003. The company provides a documented tracking and audit trail.

The scheme is not mandatory for Local Authorities. They may choose their own service provider and recoup funding, provided that the alternate service provider meets the requirements of the DEHLG.

It is estimated that the scheme will serve 1.2 million households in the Republic and will dispose of approximately 110,000 units over the period of the contract. The contract also includes the disposal of an estimated 7,000 stockpiled units. The stockpile was cleared within 1 month of the contract commencing. Generally, no site now stores any unit for more than 28 days.

The company provides monthly reports (starting in June 2004) to the DEHLG and the Department of the Environment in Northern Ireland detailing the number of units collected and processed by location. Table 4.5 provides a summary of the performance requirements of the contract.

Table 4.5. Recovery performance data.

Parameter	Performance standard
Throughput:	Average 60 units/h
The quantity of foam remaining on the granulated metal after processing will not exceed:	0.5% w/w
The quantity of compressor oil and refrigerant collected from the cooling circuit and compressor will not be less than:	99%
The compressor oil will be processed to ensure that the concentration of refrigerant remaining in the oil is less than:	<0.9% w/w
The quantity of foam remaining on the granulated plastic after processing will not exceed:	1.0% w/w
The quantity of residual blowing agent remaining in the polyurethane foam will not exceed:	0.5% w/w
The CFC and HCFC emissions to the atmosphere will not exceed:	5 g/h

The performance criteria are as per the standards set by DEFRA and the Environment Agency in the UK and are commensurate with the *Standard for the Quality Assurance and Test Specifications for the Demanufacturing of Refrigeration Equipment containing CFCs*.

4.4 Best Practice Measures

4.4.1 Imports and exports

Export and import as defined by Regulation 2037/2000 refer to movement of materials/goods into and out of the EU. The Regulation does not deal specifically with import/export between EU countries. Information is given below in relation to trade with countries outside the EU.

The import (from outside the EU) of HCFC requires an authorisation from the Commission under Regulation 2037/2000. It is the responsibility of the importer/producer to apply to the Commission. Application forms may be found on the EU website www.europa.eu.int/comm/environment/ods/index.htm and should be directed to:

Ozone Layer Protection
European Commission
Directorate – General Environment
Unit ENV.C.2 – Climate Change
B 1049 Brussels
Fax: + 32 22 99 8764
E-mail: env-ods@cec.eu.int

If an import application is approved, the Commission will allocate a portion of the available quota (calculated as per Article 3) to the applicant for import, and issue import licences. The application must be renewed each year and data on the amount of HCFC imported into Ireland must be reported annually to the Commission. A similar system is operated for export of controlled substances from the Community.

A copy of the application should also be sent to the Member State's Competent Authority.

The UNEP has published a guideline for the *Monitoring of Imports of ODS* – a guidebook (UNEP/SEI) and a *Training Manual for Customs Officers*. These should be referenced in in-house training conducted for Customs Officers.

From 1 January 2004, Article 5(1)(d)(v) of the Regulation banned the use of HCFCs for production for all foams, including polyurethane and block foams. However, Article 5(5) permits the continued use of HCFCs until 31 December 2009 for the production of products destined for export outside of the EU where the use of HCFCs in those products is not banned. The manufacturer of such products must apply to a HCFC importer/producer for supply of HCFC for this manufacturing process. The producer/importer then applies to the Commission for an allocation to supply the manufacturer (the application can be made via the ODS website). The Competent Authority in the Member State must ensure that companies only export to countries that do not have regulations/legislation banning the use of HCFCs in such equipment (Article 5(5)). Upon approval, the manufacturer will receive an EAN, confirming to the Customs Authorities that the products may be exported. Further details on the procedures for compliance with Article 5(5) can be found at http://europa.eu.int/comm/environment/ods/home/home.cfm under other documents.

CFCs can be imported only for essential uses. Such users must apply to the Commission for authorisation before any CFCs can be imported. Export from the EU of any controlled substances (including CFCs) requires

authorisation from the Commission and is only allowed under specific circumstances. Guidance Notes on application for export are included in the European ODS website
www.europa.eu.int/comm/environment/ODS/home/home.cfm

Trade with any country not party to the Montreal Protocol is prohibited, with the exception of situations where the Commission provides special authorisation (once the country has been shown to be in compliance with the requirements of the Protocol).

The Beijing Amendment to the Montreal Protocol also bans the import and export of HCFCs between countries that have not ratified the Copenhagen Amendment (which was agreed in 1992).

4.4.2 Supply and use

Suppliers or users of CFCs and HCFCs in Ireland are not required to register with the DEHLG and reliable data on suppliers were difficult to compile.

Use of CFCs is now allowed only by those who have received authorisation from the Commission for an essential use (e.g. laboratory use, medical use). The Commission requires that such essential users provide data annually to the Commission and also to the Member State Competent Authority (see Section 4.2.3.2 for further information). Importers of CFCs must also apply to the Commission for an import authorisation and report annually on quantities imported.

The use of HCFCs is still allowed at present in the maintenance and servicing of equipment; however, the quantities of HCFCs which producers can manufacture is governed under the Regulation (see Article 3(3)). Limited use of HCFCs is also allowed in other applications as detailed in Article 5. Use of HCFCs in laboratory uses, as feedstock and as a processing agent is still allowed under the Regulation.

In the UK, refrigerants are classified as *environmentally harmful substances* and from 2006 may only be supplied to registered users. Registration is controlled by a Board which will be industry led, but with government involvement. The sale of equipment containing refrigerant and the sale of refrigerant gas by a registered business will be permitted. Otherwise, it will be illegal to sell or otherwise transfer the ownership of refrigerant other than to registered businesses. There will not be any restriction on the third-party transport of refrigerant in containers on behalf of registered businesses.

In addition, many countries require users to keep records of the amounts of chemical used and to report annually to the state agency. There is currently no requirement in Ireland for HCFC users to record the amounts consumed.

A registration scheme similar to that which will be operated in the UK could also be implemented in Ireland, allowing more detailed records to be maintained of users, and quantities used annually.

4.4.3 Training and certification

A number of countries within the EU have implemented minimum qualification requirements, the most comprehensive and well established is considered to be the Danish scheme. This is described in Section 4.4.5.

The UK is currently in the process of establishing its own recognised training scheme, which will be designed to meet current and expected future legal requirements to demonstrate competence of those handling refrigerants.

- All people handling refrigerants will need to be certified as competent and will need to be employed by (or themselves be) businesses registered within a scheme managed by an overall Board. It is intended that the Board would operate on a consensus basis.
- People involved only in activities such as the transport of refrigeration equipment or containers of refrigerant will not be considered to be refrigerant handlers.
- It will be illegal to handle refrigerants unless competent to do so.

The National Vocational Qualifications (NVQs) and Scottish Vocational Qualifications (SVQs) for refrigeration and air conditioning are the current industry-recognised qualifications. They are based on standards of competence drawn up, developed and tested by industry itself. Each standard, against which the candidate's competence is assessed, covers all aspects of practical skills and the required underpinning knowledge. They are awarded through a partnership with City & Guilds. There are four qualifications, known as Series 6017 which cover:

- Small commercial refrigeration and air-conditioning systems below 10 kW input power

- Commercial and industrial non-ammonia refrigeration systems about 10 kW input power
- Ammonia refrigeration systems
- Commercial and industrial air-conditioning and heat-pump systems about 10 kW input power.

In addition, UNEP has published *Guidance on the Implementation and Design of Codes of Safe Practice in Refrigeration* and a *Training Module for National Training Courses on Good Practices in Refrigeration*. These are available at www.uneptie.org/ozonaction.

4.4.4 Leak detection

The Commission has released Standard EN 378 (*Refrigerating Systems & Heat Pumps – Safety & Environmental Specific Requirements*). The operating scope of the Standard specifies the installation of fixed refrigerant leak detectors in machinery rooms of both existing and new systems of any size, with a few exceptions for small unit and self-contained systems. It specifies that refrigerant detectors are intended to give early warning of a dangerous concentration of refrigerant vapour in the surrounding air of a refrigerating system and of pollution of the environment. The Standard specifies the action levels at which the alarms will activate.

The major manufacturers of such systems, including Mitsubishi, Toshiba, Fujitsu and Daikin, have identified the danger of leaks with direct systems and refer to the Standards with appropriate warnings in their technical manuals. They generally recommend extra ventilation and/or the use of leak detectors.

The Torremolinos Convention (under the auspices of the International Maritime Organisation) specifies that all fishing vessels with large refrigeration units should be fitted with a refrigerant leak-detection system. This is particularly important in the case of standard refrigerants, which are odourless, heavier than air, and so tend to accumulate in wells or below decks displacing air and leading to possible asphyxiation. The requirements of the Torremolinos Convention have been brought into Irish Law through Statutory Instrument 418 of 2002, Fishing Vessels (Safety Provisions) Regulations 2002.

4.4.5 Recovery, recycling and reclamation

It is considered that, as a minimum, technicians and companies involved in CFC and HCFC decommissioning should comply with international standards related to CFC and HCFC decommissioning and other reference documents which provide guidelines for the safe decommissioning of refrigeration and air-conditioning systems. International standards include:

- International Organisation for Standardization (ISO) Standard 5149 – *Mechanical refrigerating systems used for cooling and heating – Safety requirements*.

The Scottish Environmental Protection Agency (SEPA) *Guidance on the Recovery of Controlled Substances Contained in Refrigerators and Freezers*. The German Institute for Quality Assurance and Certification (RAL) awards a quality mark Demanufacture of Refrigeration Equipment Containing CFCs to companies whose practices comply with their *Quality Assurance and Test Specifications for the Demanufacture of Refrigeration Equipment Containing CFCs*. The Standard applies to the collection of refrigerator and freezer appliances, storage and processing of equipment and the handling of the materials recovered prior to reuse or disposal. The Standard has been expanded to include HCFCs, ammonia, mixtures of propane and butane, HFCs. The specification is becoming the industry standard with one disposal company in the UK now being accredited (M.D.J. Light Brothers, www.wasterec.co.uk).

The UK has published a number of guidelines for the storage and disposal of redundant units that are available on the Department for Environment Food and Rural Affairs website, www.defra.gov.uk/environment/waste/topics/fridges.

The Danish EPA has an established cooperation with a trade association, the Refrigeration Installers Association, aimed at promoting reduction of use and emissions of ODS refrigerants. The Danish EPA and the Refrigeration Installers Association have together initiated the establishment of a voluntary industry organisation, the KMO Organisation (Kølebranchens Miljø Ordning) to collect and reclaim or destroy recovered CFC, HCFC and HFC refrigerants. Almost all companies working in the refrigeration industry are members of the organisation. Criteria for membership include possession of equipment for recovery, leak tightness inspections and employment of a skilled workforce with approved certificates from specific courses. Only members of the organisation are able to buy refrigerant from the wholesalers. The UK is in the process of setting up a similar scheme.

UNEP has published Guidelines for *the Establishment of Recovery and Recycling Systems and Related Legislation for Low Volume ODS Consuming Countries*. A copy is available on their website at www.uneptie.org/ozonaction.

4.4.6 Disposal and destruction

There are a number of incineration facilities which have the capability to destroy CFCs and HCFCs within Europe (there are none in Ireland at present). Waste refrigerants can be sent to these facilities through a range of Irish waste management firms, which should ensure that the material is transported in accordance with legislative requirements including:

- Ensuring that the waste is properly notified and documented
- Ensuring that the waste is transported and labelled correctly
- Ensuring that all relevant authorities are notified of the movement of the waste
- A certificate of destruction should be requested for each load of material destroyed.

In order to encourage responsible disposal of refrigeration, Denmark has implemented taxes on refrigerants at the point of purchase. The UK has implemented a series of reward/punishment taxation measures, which are more likely to serve as the European model.

Disposal records should be maintained for a minimum 7-year period after disposal.

4.4.7 Alternatives to CFCs and HCFCs

There are numerous refrigerants on the market that have been developed as alternatives to CFCs and HCFCs. These fall into three main groups:

HCFC blends – these were introduced as alternatives to CFC-12 and CFC-502. The majority of these blends have been used in the conversion of existing CFC equipment. The use of virgin HCFC for maintenance must be phased out by 1 January 2010 and all HCFCs from 1 January 2015. Most HCFC blends were specifically developed to provide a low-cost retro-fill and were particularly useful in direct expansion CFC systems.

HFCs and HFC blends – these can be used as alternatives for both CFCs and HCFCs and have a zero ODP. All pure HFCs and most HFC blends require the use of synthetic lubricating oils in place of the more conventional mineral oils used for CFCs and HCFCs. This makes retro-fill more expensive, but it is still a practical proposition in many situations. HFCs have a high global-warming potential (although lower than those of CFCs) and must be used with care. Every effort must be made to prevent and minimise leaks. However, their favourable properties (including being non-flammable and non-toxic) make them a popular alternative in both existing and new systems. HCFC-22 has been replaced with R-407c in articulated bus and rail sites and by R-134a and R-404a in refrigerated transport containers. However, it should be noted that restrictions on the marketing and use of fluorinated compounds are forthcoming under proposed EU Regulations, currently in draft form as Commission of the European Communities *Proposal for a Regulation on certain fluorinated greenhouse gases* (COM/2003/492 Final).

Ammonia and hydrocarbons (HCs) – these so-called 'natural refrigerants' have excellent thermodynamic properties and can be used in certain systems. Ammonia may only be used in equipment specifically designed for ammonia as it is highly toxic and slightly flammable. Materials incompatibility also makes ammonia generally unsuitable for small vapour compression systems. HCs are highly flammable and should only be used in systems designed to cope with the flammability risk. As a general rule, HCs are viable alternatives in small systems and in larger systems remote from public access. HCs can only be used in existing systems if great care is taken to address safety issues.

Tables 4.6 and 4.7 provide a summary of the common refrigerant and foam alternatives for replacement or retro-filling.

The EU has published a list of companies offering ODS alternatives for foams and refrigerants which is available at www.europa.eu.int/comm/environment/ozone.

4.4.8 Implementation and incentives

UNEP recommends a number of policy instruments to assist with the phase out of ODS (refer to UNEP (2003) in References, Section 4.6.1). Table 4.8 provides a summary.

As mentioned in Section 4.4.6, Denmark has implemented massive taxes on refrigerant at the point of

Table 4.6. Alternative refrigerants.

Type of alternative	Refrigerant being replaced			
	CFC-11	CFC-12	CFC-502	HCFC-22
HCFC alternatives (retro-fill until prohibition dates of 2010 and 2015 – Article 5.1.5)	123	401A, 401B, 409A, 409B	402A, 402B, 403A, 403B, 408A, 411B	N/A
HFC alternatives (retro-fill or new)	134a (new only)	134a, 413A	404A, 407A, 407B 507	407C, 417A 410A (new only) 134A (new only)
Other alternatives (new plant only)	Ammonia	HCs Ammonia	HCs Ammonia	HCs Ammonia

Table 4.7. Alternative blowing agents.

Foam type	Blowing agent selection/option		
	CC (Pre-1996)	Transitional	Non-ozone depleting
PIR board stock	CFC-11	HCFC-141b	HFC-245fa HFC-365mfc Blends of pentane isomers
SPF	CFC-11	HCFC-141b	HFC-245fa HFC-365mfc HFC-134a Water-blown CO_2 Blends of the above
XPS	CFC-12	HCFC-142b	HFC-134a CO_2

purchase and the UK has implemented reward/punishment taxation measures that are more likely to serve as the European model.

The new UK Climate Change Levy on energy consumption adds an additional cost motivation to install detectors. This is a measure aimed at ensuring the achievement of the UK's target reduction of greenhouse gas emissions. An inefficient refrigeration plant, often caused by refrigerant leaks, also consumes excessive energy, typically up to 40%, and this will result in a substantial tax penalty for the operator. The balancing incentives include the Enhanced Capital Allowance Scheme under which an operator can claim the full cost of an investment in specified qualifying technologies against taxable income, i.e. 100% in the first year.

4.5 Summary Gap Analysis and Recommendations

Table 4.9 provides a summary of the gap analysis for Articles 16(5), 16(6), 17(1) and 17(2) as they pertain to the control and use of CFCs and HCFCs in Ireland.

Table 4.10 provides a summary of the gaps identified in the current systems in place to control the use and phase out of CFCs and HCFCs in Ireland, which are outside the scope of these Articles. Suggested recommendations are also made based on international best practice measures identified during the study.

4.6 References and Useful Information

4.6.1 References

Alliance for Responsible Atmospheric Policy (ARAP), 2002. Global Comparative Analysis of HFC and Alternative Technologies for Refrigeration, Air Conditioning, Foam, Solvent, Aerosol Propellant, and Fire Protection Applications. ARAP, UK. www.arap.org/adlittle/toc.html

Clean Technology Centre Cork, 2002. Local Authority WEE Management Practices in Ireland.

Department for Environment Food and Rural Affairs (DEFRA), 2002. Disposal of Waste Refrigeration Equipment – Advice to Small Business. DEFRA UK.

Department for Environment Food and Rural Affairs (DEFRA), 2001. Guidance for Householders on how to dispose of old fridges. DEFRA UK.

Department for Environment Food and Rural Affairs (DEFRA), 2002. Guidance on Commercial Refrigeration Equipment. DEFRA UK.

Department for the Environment, Heritage and Local

Table 4.8. Summary of incentive mechanisms.

Economic instruments	
Subsidies or tax reductions for non-ODS products, equipment or technology	A variety of ways exists for governments to promote alternative technologies or approaches, including through promoting domestic research and development, through facilitating technology transfers from abroad, or by financing industrial conversions
Assisting industrial conversion	One form of support for alternatives is to provide direct subsidies and other assistance for the conversion of industrial processes from HCFC to HCFC-free technologies. Such subsidies can overcome resistance by industry by reducing their expense and the need for large initial capital outlays. Such subsidies are particularly suited for targeting large manufacturing facilities or large-scale users
Government procurement policies	The Government, particularly the military or state-owned enterprises, but also government agencies in general can be dominant players in some sectors of the ODS market (e.g. with regard to refrigeration and air-conditioning). If the Government, acting as a consumer, leads the way by changing the specifications for the products it purchases, it can significantly catalyse the creation of a profitable market for ozone-friendly products and technologies
Excise and sales taxes	Economic incentives (lower duties, favourable loans, etc.) and disincentives (higher duties, special fees, taxes or levies, high fees or levies on approved exemptions from certain regulations, non-eligibility for economic privileges, etc.) are used by some countries as one of several tools to phase out ODS use
Legislation	
Import and export restrictions, including quotas	Controls on imports and exports of HCFCs and CFCs typically involve granting licenses to importers and setting limits on individual or aggregate annual total shipment amounts. These amounts are then tied to national goals for limiting ODS supply and use over time. Good administration of import/export controls requires good monitoring and clearance procedures, and clear and comprehensible customs codes
Leakage minimisation	Several countries, including France and the Netherlands, have imposed legislative requirements in relation to leak testing of refrigeration and air-conditioning systems. Sanctions for non-compliance include removal of the operating licence from the servicing company
Certification	Certification is used to imply that only those who fulfil certain requirements are allowed to conduct certain activities, e.g. to require that all garages that repair mobile air conditioners be certified to manage refrigerants responsibly
Voluntary approaches	
Recycling and banking of ODS	Recycling systems are important policy mechanisms for recovering refrigerants that are already in the marketplace and meeting future demand, without increasing production
Training programmes	Closely associated with certification programmes are programmes aimed at training those responsible for handling refrigerants in methods and procedures for responsible handling. These training programmes can, but do not need to be, associated with certification programmes. If certification including certain training is required for certain activities, then it will be a market-place advantage to be certified or trained in responsible ODS handling. In the longer term, training courses may then also be able to pay for themselves
Other voluntary measures and standards	Voluntary measures and standards have become increasingly popular in recent years as industry and others promote them as alternatives to government-enforced regulations or management. Companies that have agreed in advance to certain standards are, almost always, more likely to implement and comply with the standards. The downside is that these actions and standards are often weaker than necessary. The potential competition from enterprises that do not comply with a voluntary standard will make it difficult for the industry partners to the agreement to agree on measures that go beyond what they can fulfil without losing economically
Awareness raising	
Labelling	Labelling requirements help to build public awareness through educating the consumer about the impacts of their consumption decisions. Labelling can be mandated by governments as a way to promote the phase out of ODS. In such cases, products containing or produced with ODS would have to bear such a label
Public outreach and education campaigns	Public attitudes can help (positively encourage) or hinder (delay or obstruct) compliance. An informed and concerned public that supports environmental protection can pressure industries and regulators to meet environmental goals

Table 4.9. Summary of gapanalysis for Articles 16(5), 16(6), 17(1) and 17(2) in relation to CFCs and HCFCs.

Article	Situation at the time of reporting	Recommendations
Article 16(5)		
a) Promotion of the recovery, recycling, reclamation and destruction of controlled substances **b)** Assign responsibilities for ensuring compliance with Article 16(1) **c)** Define minimum qualification requirements **d)** Report to the Commission on programmes related to qualification requirements by 31 December 2001	**a)** The Local Authorities (LAs) have been charged with the responsibility to promote the recovery, reclamation and destruction of controlled substances in domestic refrigeration equipment under the all-island scheme for the management of waste fridges. In the commercial sector promotion has largely been through companies supplying refrigeration services to clients **b)** Formal responsibility for compliance with Article 16(1) has not been assigned **c)** Minimum qualification requirements have not been defined for Ireland but there is a FÁS-based apprenticeship programme and the refrigeration industry operates its own training under the remit of the Skillnet group (www.refrigerationskillnet.ie). There is an awareness of the phase out of CFCs and HCFCs, mainly due to a lack of supply **d)** No report has been submitted to the Commission; however, this gap analysis forms part of the reporting requirements to the Commission	**General recommendation** In order to effectively implement the legislation the first measure required would be the designation of a Competent Authority (CA) by the DEHLG. It is recommended that the EPA is the most appropriate CA for this Regulation. It is also recommended that the EPA and LAs are the most appropriate enforcement bodies for refrigerants (see Section 8). The CA should focus in the first instance on addressing areas of non-compliance as identified in this report, on the detailed recommendations herein and prioritise reporting to the Commission using the agreed reporting format It is also recommended that the CA should implement the following actions: **a)** • Publish a Guidance Note to assist producers, users, importers, exporters and those involved in the reuse, recovery and disposal of refrigerants • Implement a focused awareness-raising campaign targeting initially the interest groups identified through this study, e.g. within industry, to provide information leaflets and advertise in trade magazines and at conferences/trade shows (see Appendix A for contact list) **b)** • The assigned CA (the EPA, as proposed above) is formally responsible for ensuring compliance (in Ireland) with the requirements of the Regulation. The CA itself can designate responsibility to other bodies, as discussed in Section 8, which proposes an implementation strategy, establish a communication and reporting framework so that information is submitted to the LA for onward reporting to the CA and DEHLG, as necessary, to ensure recovery of ODS for destruction, recycling or reclamation (i.e. to ensure compliance with Article 16(1))

Table 4.9. ***contd***

Article	Situation at the time of reporting	Recommendations
		c) • Assign responsibility to the CA to define minimum qualification requirements. Ireland may choose to modify and supplement the apprenticeship run by FÁS or adopt the industry-led approach offered by the Skillnet group (www.refrigerationskillnet.ie), or, alternatively, adapt the British scheme for certification of handlers of refrigerants to suit the situation in Ireland **d)** • Report to the Commission on defined minimum qualification requirements
Article 16(6) **a)** Report to the Commission on systems established to promote the recovery of used controlled substances by 31 December 2001 and annually thereafter **b)** Report to the Commission on the quantities of used controlled substances recovered, recycled, reclaimed or destroyed by 31 December 2001 and annually thereafter **c)** Report to the Commission on the facilities available for recovery, recycling, reclamation or destruction of used controlled substances by 31 December 2001, and annually thereafter	**a)** The DEHLG and Department of the Environment in Northern Ireland are facilitating the operation of an all-island scheme for the management of waste domestic fridges. HCFC gas is frequently recovered from redundant commercial units and recycled for use in new units. While information was issued after release of the Montreal Protocol, it is understood that there has been no further government-sponsored awareness-raising campaigns aimed at promoting the phase out of CFCs and HCFCs or the use of alternatives in Ireland on foot of Regulation 2037/2000. Limited information is available in ENFO Briefing Sheet BS25 (www.enfo.ie) on general effects of ODS, though no information is presented on disposal methods or routes for ODS-containing equipment. However, the phase out of CFCs appears to have occurred due to the lack of supply of replacement gases. No report has been made to the Commission **b)** No reporting to the Commission is carried out on the quantities of used controlled substances recovered, recycled, reclaimed or destroyed. Information on quantities of waste ODS sent out of Ireland for destruction is available through records of Transfrontier Shipment (TFS) documentation. A system is currently in place whereby the LAs report specified data from TFS documentation to the EPA (the data required are specified by the EPA) as required for the purposes of preparing the National Waste Database **c)** A system has been developed in relation to waste domestic refrigerants. There are no facilities licensed for the destruction of CFCs and HCFCs in Ireland	**a)** • Publish a Guidance Note for the industrial, commercial and domestic sector, including a list of available disposal contractors, alternatives to traditional refrigerants and details of options for replacement of ODS-containing equipment • Ensure dissemination of the Guidance Note (web, trade fairs, workshops, etc.) to relevant industrial, commercial and domestic sectors **b)** • The information required in terms of reporting obligations under Regulation 2037/2000 is already available through TFS documentation. Therefore, it is suggested that in addition to the current reports submitted to the EPA by the LAs, the LAs are also requested to separately note any specific shipments of ODS, and report these separately to the CA **c)** • Report to the Commission on current information available and future actions planned

Table 4.9. ***contd***

Article	Situation at the time of reporting	Recommendations
Article 17(1)		
a) Precautionary measures taken to prevent and minimise leaks of controlled substances **b)** Equipment with a charge of more than 3 kg shall be checked for leaks annually **c)** Define the minimum qualifications for personnel involved in leak detection **d)** Report to Commission on programmes related to qualification requirements by 31 December 2001	**a)** No measures specified at present for refrigerants **b)** Generally equipment with a charge of more than 3 kg is not routinely checked for leaks and records are not required to be maintained. Equipment likely to be covered by this requirement includes a wide range of refrigeration and air-conditioning equipment, including common units such as supermarket refrigeration systems, roof/wall-mounted air-conditioning units, etc. **c)** There have been no minimum qualifications defined for personnel involved in leak detection **d)** No report has been submitted to the Commission; however, this gap analysis forms part of the reporting requirements to the Commission	**General recommendations** • Refer in Guidance Note to techniques for preventing leakage from refrigerator and air-conditioning systems, methods of detection such as manual checks, gas analysers and alarmed pressure gauges, and maintenance and calibration requirements for electronic detection equipment. Increase the level of awareness of EN 378 *Refrigerating Systems & Heat Pumps – Safety & Environmental Requirements*. The CA should establish a reporting system to ensure that equipment with a charge of more than 3 kg is checked for leaks annually • Assign responsibility to the CA to define minimum qualification requirements. As already recommended in 16(5)(c), Ireland may choose to modify and supplement the apprenticeship run by FÁS or adopt the industry-led approach offered by the Skillnets group and take account of leak-detection techniques or, alternatively, adapt the British scheme for certification of handlers of refrigerants to suit the situation in Ireland • Report to the Commission on defined minimum qualification requirements
Article 17(2)	**Not applicable to refrigerants**	

Table 4.10. General gap analysis review (general summary only, not exhaustive interpretation of Regulation).

Topic	Situation at the time of reporting	Recommendations
Import and export	**a)** Imports/exports for critical users are controlled under a licence system administered by the Commission as per EC 2037/2000. The licence must be renewed each year. There is only currently one such licence for CFCs **b)** Data on the total amount of CFCs imported into Ireland by critical users (from within and outside the EU) are reported annually to the Commission by the DEHLG **c)** There are discrepancies between the amount of CFC imported and the amount the only licensed user in Ireland has imported. This may be due to misidentified and mislabelled CFCs or unidentified unlicensed users or users of CFCs as a feedstock or processing agents **d)** No Irish operators have sought authorisation from the Commission to import HCFCs, indicating that HCFCs used in Ireland are sourced from within the EU **e)** One Irish exporter has been authorised by the Commission to export HCFCs outside the EU	**General recommendations** • It is recommended that the current systems controlling the import and export of HCFCs in Ireland be strengthened, to increase the level of awareness of the control dates within the Regulation. It is suggested that promotional information be developed aimed at potential HCFC importers, suppliers and users, that specifies the requirements of the Regulation in plain language. This information should be incorporated into the guidance document for operators in this sector • It is recommended that the Customs and Excise service be designated as the enforcing authority in relation to the import and export of controlled substances. Customs officers should familiarise themselves with the obligations of the Regulation and participate in occasional Commission-sponsored training as it arises. Furthermore, custom authorities should also be familiar with the UNEP website which provides access to a training manual and promotional video specifically aimed at customs officers http://www.unepie.org/ozonaction/library/training/main.html
Leak detection		
Article 17(3) requires that all precautionary measures be taken to prevent and minimise leakages of controlled substances used as feedstock and as processing agents	The situation at the time of reporting is not clear as to whether or not CFCs and HCFCs are used for these purposes	Refer in Guidance Note to techniques for preventing leakages from these uses
Disposal	**a)** There are no licensed disposal outlets for the volumes of commercial refrigerants or empty refrigerators and air-conditioning units in Ireland. The only option for the disposal of refrigerators and air-conditioning units is through licensed hazardous waste contractors for export to a waste disposal facility. In response to the Regulation, the DEHLG and the Department of the Environment in Northern Ireland under the auspices of the North South Ministerial Council sought tenders for the operation of an all-island scheme for the management of domestic waste fridges and freezers **b)** All ODS in refrigeration and air-conditioning units must be recovered during servicing/maintenance and disposal of equipment; however, this does not reflect the current practice in Ireland. Contact with industry indicates that refrigeration and air-conditioning systems containing CFC-12 are frequently topped up with R-404a and R-134a	**General recommendations** **a)** Ireland has the necessary waste legislation and systems in place to allow the export of redundant ODS to facilities that can dispose of them in an environmentally safe, effective manner. The facilities should meet international standards for the Demanufacture of Refrigeration Equipment Containing CFCs or their equivalent **b)** Awareness-raising information should be prepared with respect to the disposal of ODS for service and maintenance companies to include the classification of ODS waste using the appropriate EWC codes, the options available for disposal and the procedures to be followed, e.g. similar to the SEPA Guidance Notes for the Recovery of Controlled Substances in Refrigerators and Freezers. This should form part of the information included in the Guidance Document for this sector and should be distributed to companies within this sector

Government (DEHLG), 2003. Specification for Tender for the management of municipal waste refrigerators and freezers on an all Ireland basis. DEHLG, Ireland.

Department of Trade and Industry (DTI), 2000. Refrigeration and Air Conditioning CFC and HCFC Phase Out, UK.

EU, 2003. Proposal for a Regulation of the European Parliament and of the Council on certain fluorinated greenhouse gases COD 2003/0189.

European Commission, 2003. Implementation of Environmental Legislation in the EU Member States, summary or questions and answers session with the EU Commission.

Fingal County Council, 2000. Report on Fingal County Council CFC Gas Recovery.

German Institute for Quality Assurance and Certification (RAL), 2003. Quality Assurance and Test Specifications for the Demanufacture of Refrigeration Equipment containing CFCs. RAL, Germany.

IFBG, 2004. Far-reaching International Standards and Regulations requiring Refrigerant leak Detection Still Not Generally Known.

International Organization for Standardization (ISO), Standard 5149 – Mechanical refrigerating systems used for cooling and heating –Safety requirements.

Limerick Corporation, Information for Householders disposing of white goods and electrical appliances.

NSAI, EN 378 – Refrigerating Systems & Heat Pumps – Safety & Environmental Specific Requirements.

Scottish Environmental Protection Agency (SEPA), 2003. Guidance on the Recovery and Disposal of Controlled Substances Contained in Refrigerators and Freezers. SEPA, UK.

UNEP, 1999. Guidelines for Recovery and Recycling Systems – Refrigeration Sector. Denmark.

UNEP, 2000. Guidelines for the Development of Refrigerant Management Plans (RMPs) for Low-Volume ODS Consuming Countries (LVCs).

UNEP, Guidance on the Implementation and Design of Codes of Safe Practice in Refrigeration. A Training Module for National Training Courses on Good Practices Refrigeration. www.uneptie.org/ozonaction

UNEP, 2003. Planning Design and Implementing Policies to Control Ozone Depleting Substances Under the Montreal Protocol – A Handbook of Policy Setting at a National Level.

4.6.2 Links

Air Conditioning and Refrigeration Industry Board, Refrigeration and Air Conditioning Courses in the UK. www.acrib.org.uk

European Commission's Responses to FAQs. www.europa.eu.int/comm/environment/ozone/faqs.htm

EU, Alternatives to Ozone Depleting Substances. www.europa.eu.int/comm/environment/ozone

Refrigeration Skillsnet, www.refrigerationskillnet.ie

UNEP, Ozone Action Programme. www.uneptie.org/ozonaction/

4.6.3 Other useful information

EC and CEN (European Committee for Standardisation) countries are committed to introducing policies and measures to ensure that they meet their commitments under the Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) and there are synergies between some of these policies and measures. Towards the end of 2003, the European Commission brought forward a proposal for a Regulation of the European Parliament and of the Council on Certain Fluorinated Greenhouse Gases, 2003/0189/(COD), which is likely to be adopted in late 2004. The Regulation deals with the containment, recovery, reporting and the placing on the market of the industrial greenhouse gases under the Kyoto Protocol of HFCs, PFCs and SF_6. As currently proposed, it will impose the following requirements:

- Require owners of stationary refrigeration, air-conditioning, heat-pump equipment and fire-protection systems containing 300 kg or more of fluorinated gases to install leakage-detection systems
- Owners of stationary refrigeration, air-conditioning and heat-pump equipment and fire-protection systems containing 3 kg or more of fluorinated gases shall maintain records on the quantity and type of fluorinated gases installed, any quantities added and the quantity recovered during maintenance and servicing
- The placing of new vehicles with air-conditioning systems containing fluorinated gases with a global-warming potential higher than 150 on the market from 1 January 2009 will be subject to allocated quotas
- Each producer who produces more than 1 tonne per annum will have to report to the Commission their total production of each fluorinated gas, identifying the applications in which the substance is expected to be used and providing an estimate of the expected emissions over the life cycle of the substance and any quantities recycled, reclaimed or destroyed. Similar reporting requirements will be placed on exporters and importers.

5 Gap Analysis for Halons

5.1 Information on Halons

The term ‘halon’ is an abbreviated form of halogenated hydrocarbon. Halons have been used as a fire suppressant since the early part of the twentieth century. Small amounts of halons have also been used as components of solvents and pesticides.

Table 5.1 provides an overview of the halons scheduled for control under Regulation 2037/2000.

Table 5.1. Halons controlled under EC 2037/2000.

Halon	Chemical formula	ODP
Halon-1211	CF_2BrCl	3.0
Halon-1301	CF_3Br	10.0
Halon-2402	$C_2F_4Br_2$	6.0
Halon-1011	CH_2BrCl	0.12

It is known that other substances controlled under the Regulation have also been used in fire-suppression systems, namely HCFC-123 ($C_2HF_3Cl_2$) and HCFC-124 (C_2HF_4Cl). However, contact with the fire-protection industry during this study revealed no knowledge of fire-suppression systems employing HCFC-123 or HCFC-124 in Ireland. Therefore, the gap analysis concentrated on halon fire-suppression systems.

The system for naming halons was devised by the US Army Corps of Engineers and operates as follows:

- First digit = No. of carbon (C) atoms in the molecule
- Second digit = No. of fluorine (F) atoms in the molecule
- Third digit = No. of chlorine (Cl) atoms in the molecule
- Fourth digit = No. of bromine (Br) atoms in the molecule
- Fifth digit = No. of iodine (I) atoms in the molecule.

Halons are highly effective fire-suppressing agents for most combustion situations, but are not effective on fires involving burning metals, metal hydrides or materials that contain their own oxidising agents (such as nitrate or gun powder). Their key characteristics include:

- They leave no corrosive or abrasive residue after release
- They are non-conductive, which makes them ideal for use with electrical and electronic equipment
- They act very quickly in suppressing a fire
- When deployed at recommended volume densities, they can be used in occupied spaces as their toxicity is low.

Halon is used in both fire-suppression flooding systems and hand-held extinguishers. Halon fire-suppression systems have been commonly used in:

- Flammable liquid storage tanks
- Electronic and electrical cabinets
- Underfloor spaces
- Aircraft engine nacelles and dry bays
- Turbine or engine compartments
- Computer rooms
- Kitchens
- Paint booths.

Halon-104 (carbon tetrachloride) was reported to be the first halon to be used for fire suppression. However, the combustion products of Halon-104 are highly toxic and a more suitable material was required. In the late 1940s, Halon-1211 and Halon-1301 were identified as suitable for use in occupied spaces (i.e. low toxicity to humans). These two compounds remained the most common halons in fire-suppression systems for the remainder of the century. Halons 1011, 1202 and 2402 have also been historically used as extinguishing agents. Hand-held extinguishers usually contain Halon-1211.

Data on historical usage of halons (UNEP, 1989) indicate that typical halon consumption worldwide can be split into 40% Halon-1301, 56% Halon-1211 and 4% Halon-2402 (based on 1986 data). Contact with fire-protection companies indicated that Halon-1301 was the only halon

known to be used in flooding systems in Ireland, while Halon-1211 was employed in portable fire extinguishers.

5.2 Impact of EC Regulation 2037/2000

5.2.1 The Regulatory Authority

The Department of the Environment, Heritage and Local Government (DEHLG) is the Regulatory Authority for the implementation of this Regulation. The Competent Authority (or Authorities) for the implementation of the Regulation has not yet been designated in Ireland. The Member States' responsibilities under the Regulation include:

- Promotion of the recovery, recycling, reclamation and destruction of controlled substances. The promotional measures taken must be reported to the Commission
- Provision of an annual report to the Commission on the quantities of used controlled substances recovered, recycled, reclaimed or destroyed and the facilities available for these purposes
- Provision of an annual report to the Commission on the quantities of halons used for critical uses, the measures taken to reduce their emissions, an estimate of such emissions, and the current activities to identify and use adequate alternatives
- Specification of the minimum qualification requirements for technicians involved in recovery, recycling, reclamation and destruction of halons and reporting to the Commission by 31 December 2001 on the programmes implemented including the minimum qualification requirements for technicians involved in leak testing of halon systems
- Authorisation of bulk halon storage facilities for recovered, recycled and reclaimed halon for export for critical uses until 31 December 2009
- Notification to the Commission of the number of installations using HCFCs for fire fighting and the quantities of halons replaced by HCFCs if using the derogation in Article 5(3)
- Assignment of responsibilities to those involved in halon management to ensure that halons are handled in accordance with the requirements of Article 16.

5.2.2 Imports and exports

The terms 'import' and 'export' are defined under the Regulation as the movement of goods across the boundaries of the European Union, as opposed to national boundaries.

The Regulation does not include any specific requirements in relation to the import or export of halons into Ireland from within the European Union. The transport of halons as a waste product is covered under other pre-existing national and EU legislation including:

- *Waste Management (Hazardous Waste) Regulations, 1998*
- *Waste Management (Movement of Hazardous Waste) Regulations, 1998*
- *Waste Management (Transfrontier Shipment of Waste) Regulations, 1998*
- *The Carriage of Dangerous Goods by Road Regulations, 2001*
- *The European Communities (Safety Advisers for Transport of Dangerous Goods by Road and Rail Regulations), 2001*
- *Transportable Pressure Equipment Directive, 1999/36/EC.*

All relevant legislation must be considered when transporting halon, particularly where the material is being transferred as a waste for destruction.

The importation and placing on the market of products and equipment containing halons (from outside the EU) is prohibited, with the exception of products and equipment covered under critical uses (Annex VII of the Regulation). 31 December 2003 was the date by which mandatory decommissioning of fire-protection systems and fire extinguishers containing halons was to be completed.

Halons can be imported from outside the Community under limited circumstances. For example, controlled substances may be imported from outside the EU if they are intended for:

- Critical uses
- Use as feedstock
- Use as processing agents, or
- Destruction.

However, import from countries not party to the 1987 Montreal Protocol is prohibited.

The Regulation states that exports from the EU of halons or products and equipment, other than personal effects containing halons or whose continuing function relies on supply of those substances, is prohibited. This does not apply to halons exported to satisfy critical uses as listed in the Regulation if obtained from recovered, recycled and reclaimed halon stored for critical uses in facilities authorised or operated by the Competent Authority up until 31 December 2009. However, the Commission may decide to prohibit such exports before this time on completion of an export review in January 2005.

Import/export authorisation must be sought from the Commission and the authorisation is valid for 1 year (the quantity to be imported/exported is detailed in the authorisation). The Commission has set up a web-based ODS Declaration System to simplify the authorisation process. This can be accessed at: http://europa.eu.int/comm/environment/ods

Note that all imports/exports require authorisation, including purchases from overseas companies and the internal transfer of stocks between company branches external to the EU.

Producers, importers and exporters have annual reporting obligations under Article 19(1). In addition, under Article 1(11) of Regulation 1804/2003 exporters also have specific annual reporting obligations.

5.2.3 Supply and use

Two categories of halon use are identified under the Regulation:

1. *Critical uses* where halon systems are used in applications where alternatives have yet to be developed and implemented. Critical uses include fire-protection systems in civil or military aircraft

2. *Non-critical uses* are systems that operate using halons where viable alternatives are available (such as computer rooms).

5.2.3.1 Critical uses

Critical uses of halons are detailed in Annex VII of Regulation 2037/2000 and subsequent amendments. Table 5.2 provides a summary of current accepted critical uses.

It should also be noted that Article 5(3) of the Regulation allows the use of HCFCs as fire-fighting agents in existing fire-protection systems for the replacement of halons in applications listed in Annex VII of the Regulation, subject to certain conditions.

It should be noted that in addition to the above exemptions for Halon-1211 and Halon-1301, a number of countries which have recently joined the EU (as of 1 May 2004) have been granted critical-use exemptions for Halon-2402 in a number of applications. This exemption was granted through Commission Decision C2004(639).

Table 5.2. Critical-use exemptions.

Halon	Critical use
Halon-1301	• In aircraft for the protection of crew compartments, engine nacelles, cargo bays and dry bays, and fuel tank inerting
	• In military land vehicles and naval vessels for the protection of spaces occupied by personnel and engine compartments
	• For the making inert of occupied spaces where flammable liquid and/or gas release could occur in the military and oil, gas and petrochemical sectors, and in existing cargo ships
	• For the making inert of existing manned communication and command centres of the armed forces or others, essential for national security
	• For the making inert of spaces where there may be a risk of dispersion of radioactive matter
	• In the Channel Tunnel and associated installations and rolling stock
Halon-1211	• In hand-held fire extinguishers and fixed extinguisher equipment for engines for use on board aircraft
	• In aircraft for the protection of crew compartments, engine nacelles, cargo bays and dry bays
	• In fire extinguishers essential to personal safety used for initial extinguishing by fire brigades
	• In military and police fire extinguishers for use on persons

The Regulation requires that each year, the Competent Authority notify the Commission regarding:

- The quantities of halons used for critical uses
- The measures taken to reduce their emissions
- An estimate of such emissions
- Current activities to identify and use adequate alternatives.

Article 17 of the Regulation requires that all precautionary measures practicable are taken to prevent and minimise leakages of controlled substances. Critical users are required to implement such measures on all installed systems.

It is important to note that critical uses are reviewed annually by the Commission and categories may be removed from the list.

In order to use halons in critical-use applications authorisation must be sought from the Commission. Details of the application process are included on the European Commission web page at:
http://europa.eu.int/comm/environment/ods/home/home.cfm

Producers, importers and exporters have annual reporting obligations under Article 19(1). In addition, under Article 19(3) of the Regulation essential users are also obliged to report to the Commission annually with the following information (a copy should also be sent to the Member State Competent Authority):

- The nature of the use
- The quantities used during the previous year
- The quantities held in stock
- Any quantities recycled or destroyed
- The quantity of products containing those substances placed on the Community market and/or exported.

5.2.3.2 Non-critical uses

Regulation 2037/2000 requires that all non-critical use halon fire-protection systems be decommissioned by 31 December 2003, and the halon recovered for storage or destruction in accordance with Article 16.

Contact with industry as part of this study indicates that non-critical use halon fire-protection systems are still in use beyond the decommissioning deadline. These must be decommissioned as soon as possible in line with the requirements of the Regulation. A range of alternatives is available and these are discussed in Section 5.4.7.

5.2.4 Leak detection

Article 17 of the Regulation requires that all precautionary measures practicable be taken to prevent and minimise leaks of controlled substances. Critical users will therefore be required to implement such measures on installed systems. It should be noted that detectors are available to identify increased halon concentrations in a given space, thus providing early warning of any leaks. Such detectors are a useful method of minimising the impact of leaks that may occur; however, they should be employed in conjunction with an effective maintenance and inspection programme. Guidance on recommended approaches to control halon emissions and leak detection is included in Section 5.4.3.

Each Member State is also required to set minimum requirements for those technicians involved in carrying out leak checks.

5.2.5 Training and certification

Article 16 of the Regulation requires that Member States define the minimum qualification requirements for personnel involved in recovering and recycling halons. This has yet to be finalised in Ireland; however, once completed, all users must seek to obtain these qualifications.

Each Member State was required to report to the Commission by 31 December 2001 on programmes implemented relevant to qualification requirements.

5.2.6 Recovery, recycling and reclamation

Article 16, Paragraph 1 of Regulation 2037/2000 requires that controlled substances should be recovered during the servicing and maintenance of equipment or before the dismantling or disposal of equipment. The recovered halon may be sent for recycling, reclamation or destruction by technologies approved by the Parties (or by any other environmentally acceptable destruction technology). Regulation 2037/2000 defines recovery, recycling and reclamation as follows:

- *Recovery* is the collection and the storage of controlled substances from, for example, machinery,

equipment and containment vessels during servicing or before disposal

- *Recycling* is the reuse of a recovered controlled substance following a basic cleaning process such as filtering and drying. For halons, recycling *normally involves* recharge back into equipment for critical uses

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

All halons should be recovered rather than allowing venting to the atmosphere or disposal through unacceptable means such as land filling of cylinders. After recovery, the halons may then be subject to recycling, reclamation or disposal.

Only critical users of halon, as defined in Annex VII of Regulation 2037/2000, are permitted to use halon in fire-suppression systems. Halons from decommissioned systems may be recycled for use in critical systems. Under Regulation 1804/2003, if these are to be exported they must be stored in facilities authorised or operated by the Competent Authority.

5.2.7 Disposal and destruction

Unwanted halon cylinders would be considered a hazardous waste under both EU and national legislation. The appropriate European Waste Code (EWC), as specified in Commission Decision 2000/532/EC and its amendments, should be used for all ODS wastes.

Suitable technologies (as agreed by the Parties to the Montreal Protocol) for the destruction of halons include:

- Liquid injection incineration
- Reactor cracking
- Gaseous/fume oxidation
- Rotary kiln incinerator
- Cement kilns
- Radio frequency plasma destruction technology.

There are currently no facilities licensed for the destruction or storage of halons in Ireland. At present material for destruction is typically transported to the UK through waste brokers operating in Ireland.

There are a number of incineration facilities in the UK and also a facility which uses a plasma conversion process to destroy halon. Waste halon can be sent to these facilities through a licensed hazardous waste contractor or broker. The material must be transported in accordance with legislative requirements including ensuring that:

- The waste is properly notified and documented
- The waste is transported and labelled correctly
- All relevant authorities are notified of the movement of the waste.

A certificate of destruction should be requested for each load of material destroyed.

5.3 Baseline Analysis

Contact was made with a number of companies involved in halon management in Ireland including:

- Halon users (critical and non-critical)
- Fire-protection companies who install and decommission systems
- Waste brokers involved in exporting halons for disposal in the UK
- Department of Communications, Marine and Natural Resources
- Advisory bodies in the UK.

The survey contact list is included in Appendix B.

5.3.1 Imports and exports

Data from the Central Statistics Office indicate that there were no import of halons declared between 1998 and 2002. However, discussions with industry during this survey indicate that small quantities of halons have been imported from the UK by at least one critical user. Quantities of halons have also left the country for destruction in the UK. This material would have been classified as a waste and hence would not have been included in the export statistics. Transfrontier shipment of waste documentation is sent to the EPA by Local Authorities for collation.

5.3.2 Supply and use

Contact with members of the fire-protection industry indicated that decommissioning of halon-flooding systems has been ongoing over recent years. However, it was also reported that halon systems are still known to be operated by non-critical users.

The fire-protection industry has advised such users on replacements; some firms have chosen to continue using halon-flooding systems due to a perceived lack of enforcement of the Regulation. Such users have decided not to replace these systems whilst they maintain a halon charge and are operational. These systems typically operate as flooding systems in electrical/computer rooms, flammable liquid storage areas, boiler rooms and on board fishing vessels and cargo ships.

It is estimated that the quantity of portable halon fire extinguishers presently in use is relatively low. Contact with fire-protection firms indicates that a large number of these units were decommissioned during the 1990s and replaced with other extinguisher types due to the difficulties in sourcing halon after the production ban in 1993. Thus, any facilities which have a maintenance contract with a fire-protection company would not be expected to have portable halon fire extinguishers. Research during this study indicated that portable halon fire extinguishers may be found in homes, cars (particularly those involved in motor sports), boats (pleasure craft, fishing boats and cargo vessels) and occasionally in commercial/industrial facilities.

In relation to Table 5.2, which indicates a critical-use exemption for *the making inert of occupied spaces where flammable liquid and/or gas release could occur in the military and oil, gas and petrochemical sectors, and in existing cargo ships*, it should be noted that Marine Notice No. 38 of 2003 (issued by the Marine Survey Office of the Department of Communications, Marine and Natural Resources) indicates (after consultation with the Commission) that this does not apply to any Irish-registered vessels and indicates that any vessel retaining a halon system after 31 December 2003 will be in breach of the Regulation.

Critical users identified during the course of this report include the Irish Air Corps and also FLS Aerospace (for servicing of Aer Lingus aircraft). Neither of these users has applied for exemptions to the Commission.

In terms of supply, the fire-protection industry reports difficulty in sourcing halon for the last 3–4 years. One critical user in Ireland (FLS Aerospace) has reported sourcing halon from the UK through HUNC (Halon Users National Consortium) and also from a decommissioned facility in Dublin (Aer Lingus computer room). Whilst sourcing of recycled halon by critical users is allowed under the Regulation, it is important that all halon usage is reported to the Commission. This is not being carried out at present. Article 4(4)(iv) requires that Member States shall notify the Commission annually of the quantities of halons used for critical uses, the measures taken to reduce their emissions and an estimate of such emissions, and the current activities to identify and use adequate alternatives.

5.3.3 Training and certification

The Regulation requires that Member States define the minimum qualification requirements for personnel involved in the recovery and recycling of halons. These qualification requirements have yet to be defined in Ireland for technicians working with fire-suppression systems. Once implemented, all technicians will be expected to obtain the relevant qualifications.

Contact with a number of facilities involved in the decommissioning of halon fire-protection systems in Ireland has indicated that training of technicians is carried out in-house with no external verification of the qualifications.

5.3.4 Leak detection

There are no requirements specified in Ireland for leak detection of halon systems or for minimum qualification requirements of technicians involved in leak-detection operations.

A company in Dublin (Murco Ltd) has been identified which provides electronic gas detection equipment, including systems for the detection of halons. Such systems are likely to be suitable for continuous leak detection. Guidance on leak detection is given in Section 5.4.3.

Fire-protection companies in Ireland should also be able to provide regular leak-detection surveys as required, once technicians have attained the minimum qualification requirements. This would typically involve a twice yearly leak check.

5.3.5 Recycling, recovery and reclamation

There are no commercial recycling, recovery or reclamation facilities in Ireland at present. Facilities are available in the UK for destruction as discussed in Section 5.3.6.

FLS Aerospace operates equipment for reclamation of halon for reuse in aircraft systems; however, this is solely for their own use.

Historically, another Irish facility (AJ Edge Fire Protection) operated a facility where portable halon extinguishers were accepted for recycling. Halon was decanted from the cylinders, filtered and placed into new cylinders. The main clients for these cylinders were reported to be the US Navy, the Royal Ulster Constabulary (now the Police Service of Northern Ireland) and the Irish Army (Air Corps). AJ Edge ceased this service in 2001. Prior to this, approximately 2,000 cylinders were reportedly recycled each year.

5.3.6 Disposal and destruction

All transfrontier shipments of waste should be accompanied by the required TFS (Transfrontier Shipment) documentation under the Waste Management (Transfrontier Shipment of Waste) Regulations, 1998. This documentation is forwarded to the relevant Local Authority. The Local Authority then forwards summary information from this document to the EPA in the format specified by the Agency for the purpose of maintaining national statistics on the export of waste.

Fire-protection firms indicated that a significant amount of decommissioning was carried out in 2002/2003, particularly in larger institutions such as banks and telecommunication companies. However, it is reported that a number of halon systems remain in operation in smaller facilities.

Discussions with a number of waste brokers in Ireland further confirmed that quantities of both Halon-1301 and Halon-1211 were exported from Ireland for disposal, particularly in 2002/2003. Data from disposal of this material are available on TFS documentation records held by the EPA. For example, summary TFS data from the EPA indicate a total of 21,116 kg of waste halon-containing equipment (cylinders) exported from Ireland in 2003.

The majority of waste halon is reported to come from halon-flooding systems (with 30–40 kg of halon in a single large cylinder). Only a small number of hand-held halon extinguishers are still being disposed off. Based on discussions with fire-protection contractors, it is understood that a large number of hand-held extinguishers are likely to have been removed from facilities during the 1990s.

Contact with commercial and industrial facilities which use halon fire-suppression systems has indicated a lack of knowledge with regard to the requirements of the Regulation; thus, not all systems have met the deadline of 31 December 2003.

5.4 Best Practice Measures

5.4.1 Imports and exports

Imports/exports between EU countries are not specifically covered by the Regulation; however, the shipment of waste halons within the EU is governed by other national and EU legislation. Notification and prior informed consent procedures must be followed for each Member State involved in the dispatch, transit and destination under EC Regulation 259/93 (on the shipment of waste within, into and outside the EU). The relevant national legislation is the *Waste Management (Transfrontier Shipment of Waste) Regulations, 1998.*

The requirements of Regulations 2037/2000 and 1804/2003 should be strictly adhered to, namely:

- The importation and placing on the market of products and equipment containing halons is prohibited, with the exception of products and equipment covered under critical uses (Annex VII of the Regulation)
- Controlled substances may be imported from outside the EU if they are intended for critical uses, used for feedstock or as processing agents, or if they are being imported for the purposes of destruction. Import from countries not party to the 1987 Montreal Protocol remains prohibited
- The Regulation states that exports from the EU of halons or products and equipment, other than personal effects containing halons or whose continuing function relies on supply of those substances, shall be prohibited. This does not apply to halons exported to satisfy critical uses as listed in the Regulation if obtained from recovered, recycled and reclaimed halon stored for critical uses in

facilities authorised or operated by the Competent Authority up until 31 December 2009. Export authorisation shall be sought from the Commission and the authorisation is valid for 1 year.

Those wishing to import or export controlled substances must receive prior authorisation from the Commission. The Commission operates an ODS declaration system which requires those who wish to import/export controlled substances to declare intended imports/exports for the following year. The declaration system can be accessed through their website at:
http://europa.eu.int/comm/environment/ods

Those wishing to import or export controlled substances must apply to the Commission (also sending a copy to the Competent Authority) in advance to receive authorisation. Enquiries can be made to:

Ozone Layer Protection
European Commission
Directorate – General Environment
Unit ENV.C.2 – Climate Change
B-1049 Brussels
Belgium.

For those applying for export authorisation, an Export Authorisation Number (EAN) will be provided and the applicant notified providing the application meets the eligibility criteria. From 31 December 2003, exports from the Community of halon for critical uses not from storage facilities authorised or operated by the Competent Authority to store halon for critical uses shall be prohibited.

For those applying for an import authorisation, the applications will be considered by the Commission and import quotas will be set for each importer. Parties which have been assigned a quota must then apply to the Commission for an import licence. Provided the Commission is satisfied that the request is in accordance with the quota authorised and conforms to the requirements of the Regulation, an import licence will be issued. A certificate of analysis may also be requested.

5.4.2 Supply and use

Halons can be used only in the critical-use categories outlined in Table 5.2. Non-critical systems should be decommissioned by 31 December 2003. Each year, the Competent Authority shall notify the Commission of the quantities of halons used for critical uses, the measures taken to reduce their emissions and an estimate of such emissions, and the current activities to identify and use adequate alternatives. No reporting system presently exists in Ireland. Hence, the appointed Competent Authority must set up a system to gather data from critical users (and also to ensure that these users are classified as critical under the Regulation, hence a licensing or registration system would be useful) on halon usage, to estimate emissions from these systems and to identify and promote the use of adequate alternatives.

Article 17 requires that all precautionary measures practicable are taken to prevent and minimise leakages of controlled substances. Critical users will therefore be required to implement such measures on all installed systems. It should be noted that detectors are available to identify increased halon concentrations in a given space, thus providing early warning of leaks. Such detectors are a useful method of minimising the impact of leaks but should be employed in conjunction with an effective maintenance and inspection programme. Guidance on recommended approaches for control of halon emissions and leak detection is included in Section 5.4.3.

In addition, critical users in Ireland must maintain detailed records of halon usage including:

- Source of halon supply
- Quantities used
- Type
- Where it is used
- Leakages
- Accidental discharges.

The Commission (European Commission, 2000) indicates that critical users must estimate their future needs and arrange for procurement and storage of appropriate volumes of halons. It is recommended that either:

- Individuals make their own arrangement to stockpile halons, or
- Groups of users collaborate to operate a consortium stockpile, or
- A third party with appropriate standards of storage and maintenance is subcontracted to stockpile halons on behalf of a user or group of users.

There are currently no halon banks in Ireland; however, critical users may be able to source halons through clearing houses or through direct contact with facilities that are in the process of decommissioning halon systems (or through the fire-protection company carrying out the decommissioning). Contacts for clearing houses can be found at:

- Halon Users National Consortium (HUNC) in the UK (www.hunc.org)
- The United Nations Environment Programme Halon Trader Facility (www.halontrader.org).

5.4.3 Leak detection

Best practice measures for leak detection are considered to include a combination of continuous automated monitoring and regular manual checks. In addition to minimising and preventing leaks, the emission of halons to the atmosphere from systems can be minimised through adhering to safety guidelines.

The EU Commission (2000) provides the following general comments to help avoid accidental halon discharge:

- Reduce or eliminate altogether commissioning and maintenance tests, the largest cause of halon emissions
- Avoid carelessness by end-users when, for example, fire-detection systems are accidentally triggered by smoke or heat from an activity carried out in close proximity to the detection mechanism
- Avoid poor handling by service engineers that causes halons to be accidentally released when the extinguishing systems are not locked off or placed on manual before testing
- Ensure sufficient system maintenance in order to avoid accidental discharges caused by a malfunction of the detection system.

Guidance for critical users is also provided by UNEP (2001) and includes the following issues:

- Halon use, alternatives and inventory management by the aviation sector
- Safety in halon decommissioning
- Military applications and halon management.

Critical users should refer to this document for guidance.

The control of halon emissions during decommissioning is also an important issue and should only be carried out by suitably qualified technicians. General guidelines to be considered during decommissioning of halon systems are included in Appendix D.

Methods for leak detection and minimisation include:

- Regular inspection and recording of cylinder condition and pressure
- Installing monitoring systems in rooms containing fire-suppression systems to monitor airborne gas concentrations
- Pressure testing of cylinders on a regular (e.g. every 4 years) basis to check integrity of cylinder
- Automated monitoring of cylinder pressure and alarm at pre-set pressure drop.

A combination of regular inspection by suitably qualified personnel and continuous monitoring is considered to be the most effective method of minimising halon leaks. Pressure testing of the cylinder should also be carried out if required by the cylinder manufacturer or the halon system installation company/manufacturer.

5.4.4 Training and certification

The British Approvals for Fire Equipment (BAFE) operates a registered scheme for halon decommissioning. The scheme imposes responsibilities on both the technician and the company employing the technician. The technicians must undertake a training course and exam to provide evidence that they fully understand the relevant aspects of halon system decommissioning and that they are competent to carry out the work. The company employing the technicians must meet minimum standards to ensure that appropriate processes are in place to record and control the removal, storage, disposal or reuse of the halon. Contact with BAFE has indicated that training courses for technicians are no longer offered though the qualifications are still valid in terms of decommissioning any remaining halon systems.

As a minimum, technicians and companies involved in halon decommissioning should comply with international and Irish standards relating to halons and halon decommissioning. These include:

- IS EN 27201-1:1994. *Fire Protection – Fire Extinguishing Media – Halogenated Hydrocarbons – Specifications for Halon-1211 and Halon-1301* (equivalent to ISO 7201-1:1989)

- IS EN 27201-2:1994. *Fire Protection – Fire Extinguishing Media – Halogenated Hydrocarbons – Code of Practice for Safe Handling and Transfer Procedures* (equivalent to ISO 7201-2:1989).

Guidance on the safe handling and decommissioning of halons is also included in a number of the references given in Section 5.6 including: EU Commission (2000) and UNEP (1989, 1999, 2001). A summary of guidance provided in these documents in given in Appendix D. Technicians operating in Ireland should also refer to the Guidance Document on the Regulation which is to be published by the Competent Authority. The above-referenced guidance and standards should be referred to in all in-house training for technicians involved in decommissioning, servicing and leak detection of halon systems.

5.4.5 Recovery, recycling and reclamation

There are currently no commercial facilities in Ireland for the recovery, recycling or reclamation of halons. Recovery of halons from fire-protection systems for use in critical-use systems should only be carried out by suitably qualified personnel to minimise the potential for inadvertent halon release to the atmosphere.

Halons from decommissioned systems may be transferred directly to critical users in Ireland or elsewhere in Europe. There are a number of clearing houses which facilitate the exchange of halons between users. The use of a clearing house reduces the disposal costs for those decommissioning their systems and provides a source of halons for critical users. Contacts for clearing houses can be found at:

- Halon Users National Consortium (HUNC) in the UK (www.hunc.org)

- The United Nations Environment Programme Halon Trader Facility (www.halontrader.org).

Article 16(6) requires that Member States report to the Commission (by 31 December 2001) on the facilities available for the recovery of used controlled substances and the quantities of used controlled substances recovered, recycled, reclaimed or destroyed. It is understood that this has not been carried out for halon in Ireland. It is considered that a reporting system is required to gather this information. The system could be based on the disposal data which can be gathered from TFS documentation records maintained by the EPA, in addition to data from halon clearing house such as those referenced above (for halons sent for recovery or reuse rather than destruction).

5.4.6 Disposal and destruction

There are currently no facilities in Ireland for the destruction of halons. However, cylinders can be exported to the UK (or elsewhere) for destruction or recovery in accordance with existing EU and national legislation. A number of destruction facilities are currently licensed by the UK Department of the Environment, Food and Rural Affairs. Table 5.3 provides contact details.

The fire-protection company decommissioning the system is typically able to arrange for disposal of halon via a waste management contractor. Decommissioning and transport of cylinders should only be carried out by qualified personnel and should be carried out in line with available guidance (see Appendix D). Written confirmation should be obtained to confirm that the material has been disposed off at a suitable facility. Under no circumstances should halon cylinders from fire-suppression systems be disposed off as general refuse or discharged to the atmosphere.

Disposal records should be maintained for a minimum 7-year period after disposal.

Table 5.3. Licensed halon disposal facilities.

Cleanaway Ltd	**Shanks Waste Solutions**	**DASCEM Europe Ltd**
Bridges Road	Charleston Road	Peas Road
Ellesmere Port	Hardley	North West Industrial Estate
Cheshire	Hythe	Peterlee
CH65 4EQ	Southampton	Co. Durham
Tel: +44 151 348 5000	SO45 3ZA	SR8 2RD.
	Tel: +44 1908 650650	Tel: +44 191 587 4600

5.4.7 Alternatives to halons

Contact with Irish fire-suppression maintenance and installation companies indicated that FM-200 (a trade name for HFC-227ea) is the most popular replacement for Halon-1301 in flooding systems. Nitrogen-flooding systems have also been installed in some cases.

Significant effort has been made internationally to find a suitable alternative to halon in fire-suppression systems. A number of potential alternatives are examined briefly in the following section, looking at alternatives for both fixed systems and portable hand-held extinguishers. A number of references are also included in the following sections which provide further information on the halon alternatives available.

The European Commission (2000) recommended that alternatives be selected on the basis of lowest possible environmental impact, consistent with personnel safety, speed of suppression, volume, weight and cost for protecting life and the environment from fire.

The choice of an alternative depends on many factors including the type of hazard being protected, the characteristics of the alternative method (e.g. ability to extinguish solid and/or liquid fuel fires), and the risk management philosophy of the use. The toxicity of the alternative method should also be considered if there is potential for human exposure.

Other factors which may be important in particular cases include:

- Minimal conductivity for electrical fires
- Ability to permeate to the source of the fire in cases where access is difficult
- Capacity to extend over the required distance
- Having a minimum weight or volume claim
- Causing minimal secondary damage after use.

5.4.7.1 Fixed systems

Table 5.4 provides a summary of the existing alternatives and their advantages and disadvantages. The information provided in Table 5.4 is taken from the following documents:

- UNEP, 2001: *Standards and Codes of Practice to Eliminate Dependency on Halons*
- UNEP, 1999: *Eliminating Dependency on Halons – Self Help Guide for Low Consuming Countries*
- UNEP, 1989: *Final Report of the Halons Technical Options Committee*
- UK DETR/DTI, 2001: *Phase Out of Halons – Advice on Alternatives and Guidelines for Users of Fire Fighting and Explosion Protection Systems*.

5.4.7.2 Portable fire extinguishers

Halon-1211 is typically employed in hand-held fire extinguishers. The replacements for halon in these extinguishers are similar to the potential replacements outlined for halon-flooding systems. Table 5.5 gives a summary of the advantages and disadvantages of alternatives typically employed in portable extinguishers.

5.4.8 Implementation and incentives

The EU Commission (2000) provided an outline of potential incentives to encourage halon phase out in line with the requirements of Regulation 2037/2000. It also outlined methods of publicising the requirements for such phase out. Guidance on raising public awareness on the need for halon phase out is also available from UNEP (1999).

The European Commission recommends three types of incentives:

1. Economic incentives

Direct economic incentives include subsidising the installation of halon alternatives, providing that any decommissioned halon is either stockpiled for critical uses or is appropriately disposed. Other incentives include subsidising halon disposal costs.

Indirect economic incentives apply an indirect value to halon through the use of duty exemptions, grants and reduced rate loans for the installation of alternatives.

2. Legislation

Enforcement procedures can be developed to encourage the phase out of halons, with penalties for ongoing use and also for illegal venting or disposal. The EU Commission specifies that penalties should be effective, proportionate and dissuasive in order to discourage breaches of the Regulation.

3. Voluntary approach

As the deadline for decommissioning of non-critical halon systems has passed, the opportunity for use of a voluntary

Table 5.4. Summary of the existing alternatives for fixed halon systems.

Alternative	Advantages	Disadvantages
Halocarbons. Alternatives include HCFCs, HFCs and PFCs. FM-200, a common replacement for halons in Ireland is a trade name for HFC-227ea	• Electrically non-conductive • Clean agents (no residue) • Can be stored and discharged from fire-protection systems that are similar to that used for Halon-1301	• All (except CF_3I) are less efficient fire extinguishers than Halon-1301 in terms of storage volume and weight, hence the use of these agents requires increased storage capacity • All (except CF_3I) produce more decomposition products (primarily HF) than Halon-1301 • Are more expensive than Halon-1301 • Use of HCFCs as a halon replacement in fire-protection systems is limited under the requirements of Regulation 2037/2000 (such as the HCFC supplier must cover 70% of the destruction costs) under Article 5(3). The Commission therefore expects that use of HCFCs as alternatives to halons in the EC will be negligible (European Commission, 2000) • HFCs and PFCs are greenhouse gases and are regulated under the Kyoto Protocol and will also be regulated under the proposed *Regulation of the European Parliament and of the Council on Certain Fluorinated Greenhouse Gases*, COM(2003) 492 Final
Inert Gases. Common inert gases used in fire-protection systems include: nitrogen, argon, nitrogen/argon blend, and nitrogen/argon/CO_2 blend	• Electrically non-conductive • 'Clean' fire suppressants (i.e. no residue) • Are not subject to thermal decomposition and hence form no by-products • Have no global-warming or ozone-depletion properties	• Are stored as high pressure gases. This results in increased storage volume requirements, health and safety requirements and increased weight • Discharge time for these systems is of the order of 1–2 min. This may limit some applications involving very rapidly developing fires • Some concerns in relation to reduced oxygen concentration when these gases are released in occupied spaces
Fine Water Mist. This technology involves the release of water in small droplets (10–200 nm). Types of system include: • Single fluid systems (i.e. water only) at low–moderate pressure (3–50 bar) • Single fluid systems at high pressure (>50 bar) • Dual fluid systems (which use nitrogen or another gas to atomise water at the nozzle)	• Water application rates are approximately 100 times less than conventional sprinkler systems. The mists do not conduct electricity as readily as solid water streams and hence can be considered for use on electrical equipment • Reasonably weight efficient • Reported to be safe for use in occupied areas • No ozone-depletion or global-warming properties	• Do not always guarantee the extinguishing of fires. Small obstructed fires may require response team intervention • The droplet size must be sufficiently small to ensure adequate distribution of water throughout the compartment • These systems are still relatively new and have not been as rigorously tested or developed as other traditional systems
Inert Gas Generators. This system utilises a solid material which oxidises rapidly to produce large quantities of CO_2 and/or nitrogen	• Have been used in military applications (particularly aircraft) • Have no ozone-depletion or global-warming properties	• Their use in non-military applications is limited at present as further development is required

Table 5.4. ***contd***

Alternative	Advantages	Disadvantages
Fine Particle Aerosol Generators. This technology is still under development. It relies on the properties of solid particles to suppress fires; however, the 'collateral' damage due to use of these generators would be considerably lower than traditional dry-powder technologies	• Considered to be a relatively low-cost/low-technology technique	• Development is still ongoing and at present these generators are not considered a viable replacement for halon systems
Detection and Manual Intervention. This involves the use of highly sensitive smoke-detection and aspiration systems, which allow early detection of the fire and manual intervention (hand-held extinguishers or hose reels) before the fire is out of control, or to minimise fire spread while waiting for the fire services	• Early detection and intervention reduces fire damage • Hand-held extinguishers can be employed which have no ozone-depleting or global-warming potential • Cheaper than installation of complex suppression systems, lower maintenance	• Potentially increase health and safety risk to staff • If the fire goes out of control, there is no option but to wait for the fire services to intervene, unless a manual backup flooding system is available • Use of some portable extinguishers can result in significant collateral damage (e.g. use of water on electrical equipment) • This methodology is suitable only for certain types of hazard and should be examined carefully in terms of the types of fires that are likely to occur in a given application • Can be a significant change where previous methods have involved automatic fire-suppression systems
Water Sprinklers. Traditional water-sprinkler systems are commonly employed in Ireland in a number of different types of applications. These systems simply release a deluge of water to extinguish the fire	• Systems are very reliable and are highly unlikely to discharge accidentally. They can also be designed to activate only after two separate detection systems have been activated, thus further reducing the potential for accidental releases • Systems have been proved effective in extinguishing fires, but the potential types of fires should be examined carefully as not all fire types are effectively extinguished (see Disadvantages)	• Not ideally suited for use on live electrical equipment, flammable liquid fires, or in any area where materials may react violently with water • Systems are likely to result in significant water damage to equipment; however, this must be weighed against the potential damage which would result from an unhindered fire • Fires which occur in enclosed spaces such as computer or electrical cabinets may not be effectively extinguished unless a nozzle is installed in the enclosed area
Carbon Dioxide. This method involves flooding the area with CO_2 gas to extinguish the fire and has been successfully employed for a number of years in varied applications. Suitable applications include: • Telecommunications facilities • Computer and control rooms • Transformer rooms, switchgear rooms and machinery spaces • Record storage and cultural heritage facilities • Flammable liquid hazards	• CO_2 is a 'clean' fire suppressant • CO_2 gas is electrically non-conductive • CO_2 gas has good penetration into obstructed areas	• CO_2 is toxic and an asphyxiant, and so should not be used in occupied spaces, or should be locked off when protected spaces are occupied. CO_2 is also odourless and so malfunctions may not be detected • CO_2 is stored at high pressure. High concentrations are required to ensure effective fire suppression. This has storage volume and weight implications for the design of suppression systems • CO_2 is controlled under the Kyoto Protocol as it is known to cause global warming

Table 5.4. ***contd***

Alternative	Advantages	Disadvantages
Foam Systems. These systems operate by forming a barrier between the fire and the supply of oxygen as well as having a cooling effect. Different types of foam include low, medium and high expansion foams	• Low/medium expansion foams are most suited to liquid pool fires, while high expansion foam is more suitable as a flooding agent for areas such as document storage facilities • May be capable of being delivered through traditional water-sprinkler equipment, thus increasing the extinguishing efficiency • No ozone-depleting or global-warming potential	• Risk of suffocation if discharge occurs in occupied areas • Not suitable in applications where materials may act violently with water as the foam solution contains water • Care must be taken in selection of the foam agent, as certain liquids (such as alcohols) can destroy some foam blankets • May not be effective in extinguishing fires in enclosed spaces such as cabinets unless a dedicated nozzle is installed in these areas
Dry-Powder Systems. Operate by releasing powder onto the fire to prevent oxidation thus extinguishing the fire. Different types of dry-powder systems are available including: • Formulations based on sodium bicarbonate are suitable for fires involving flammable liquids and gases • Multipurpose dry-powder systems are based on formulations of ammonium dihydrogenphosphate and are also suitable for use on fires involving ordinary combustibles such as wood or paper in addition to flammable liquids and gases	• Electrically non-conductive and hence can be used safely in areas containing electrical equipment • No ozone-depleting or global-warming potential	• Residues are left after application of dry powders • As mentioned above, some dry powders may not be suitable for all fires. The types of powder being used should be examined closely • Powders are ineffective once the powder has settled • Some powders exhibit toxic effects. This should be investigated prior to release in occupied areas. The release of powders will also obscure visibility

Table 5.5. Replacement agents in portable extinguishers (UNEP, 1999).

Type	Ordinary combustibles	Flammable liquids	Electrically non-conductive	Ability to permeate concealed spaces	Stream range	Effective weight	Secondary damage
CO_2	Poor	Fair	Yes	Good	Fair	Poor	Good
Dry powder	Good	Good	Yes	Fair	Very good	Good	Poor
AFFF	Good	Fair	No	Poor	Good	Poor	Poor
Water stream	Good	Ineffective	No	Poor	Good	Poor	Poor
Water fog	Good	Fair	Yes	Fair	Fair	Fair	Fair
Halocarbons	Good	Good	Yes	Good	Good	Good	Good
Halon-1211	Good	Good	Yes	Good	Good	Good	Good

approach is not a suitable option in Ireland. Decommissioning of the remaining systems should be completed as soon as practicable. Whilst many facilities in Ireland have voluntarily decommissioned halon systems without prompting from a Competent Authority, those remaining should be informed through awareness raising (see next section) of the obligations for replacement systems to be installed.

5.4.8.1 Awareness raising

This will be a vital aspect in decommissioning the remaining halon systems in Ireland. Suppliers and users should receive specific and relevant information on the requirements for halon phase out, including such information as:

- Data on alternatives (advantages, disadvantages, environmental impact)
- Advice and information can be made available to industry and to fire-equipment contractors through the Fire Services section of the DEHLG and through the Fire Services section of Local Authorities (where applicable)
- Details of manufacturers and suppliers of suitable equipment.

Further details on the type of information to be supplied are presented below.

5.4.8.2 Publicity on halon decommissioning

Both the EU Commission (2000) and UNEP (1999) recommend that awareness on the requirements for halon decommissioning be targeted at a number of specific sectors including:

- Data processing and telecoms facilities
- Air, rail and marine transport, both public and commercial
- Insurance industry
- Oil, gas, petrochemical and process plant
- Military
- Fire services
- Standards writing organisations.

Depending on the sector, the best approach may be direct contact (e.g. military), through trade magazines, through trade associations or through suppliers.

Examples of publicity materials and methods include:

- A one- or two-page brochure that provides an overview of the salient points of the Regulation
- A Guidance Document which provides detailed information on the regulatory requirements
- A website with links to other sources of information including information on the regulations, decommissioning options, clearinghouse contacts, alternatives suppliers
- Articles in trade publications
- Conferences and workshops targeting various industry sectors, or alternatively presentations at trade conferences.

Examples of a small brochure and a presentation on halon decommissioning are included in a UNEP document published in 1999 (see Section 5.6.1).

5.5 Summary Gap Analysis and Recommendations

Table 5.6 summarises the gap analysis for the halon sector. In addition to detailing gaps related to Articles 16 and 17 of the Regulation, Table 5.7 provides an overview of other gaps that have been identified during the course of this study. Recommendations are also included on how these gaps may be addressed based on a review of best practice measures.

5.6 References and Useful Information

5.6.1 References

DETR/DTI, 2001. *Phase Out of Halons. Advice on Alternatives and Guidelines for Users of Fire Fighting and Explosion Protection Systems*. Department of Trade and Industry, London.

European Commission, 2000. *Strategy for the Management and Elimination of the Use of Halons in the European Community*. European Commission, Brussels.

UNEP, 1989. *Final Report of the Halons – Technical Committee*. UNEP Montreal Protocol Assessment Technology Review. UNEP, Paris.

UNEP, 1999. *Eliminating Dependency on Halons: Self Help Guide for Low Volume Consuming Countries.*

Table 5.6. Summary of gap analysis for Articles 16(5), 16(6), 17(1) and 17(2) in relation to halons.

Article	Situation at the time of reporting	Recommendations
Article 16(5)		
a) Promotion of the recovery, recycling, reclamation and destruction of controlled substances **b)** Assign responsibilities for ensuring compliance **c)** Define minimum qualification requirements **d)** Report to the Commission on programmes related to qualification requirements by 31 December 2001	**a)** No centrally directed promotion at present; however, recommendations for promotional measures are included in the main gap analysis report **b)** No formal assignment of responsibility at present **c)** No minimum qualifications defined and no suitable courses run in Ireland at present. It should be noted that research carried out in preparing this report indicates limited ongoing use of halon systems **d)** No report has been issued to the Commission; however, this gap analysis forms part of the reporting requirements to the Commission	**General recommendation** In order to effectively implement the legislation, the first measure required would be the designation of a Competent Authority (CA) by the DEHLG. It is recommended that the EPA is the most appropriate CA for this Regulation. It is also recommended that the EPA and LAs are the most appropriate enforcement bodies for halons (see Section 8). The CA should focus in the first instance on addressing areas of non-compliance as identified in this report, on the detailed recommendations herein, and prioritise reporting to the Commission using the agreed reporting format. It is recommended that the CA should implement the following actions: **a)** • Publish a Guidance Note to assist producers, users, importers, exporters and those involved in the reuse, recovery and disposal of halons • Implement a focused awareness-raising campaign targeting initially the interest groups identified through this study, e.g. within industry, to provide information leaflets and advertise in trade magazines and at conferences/trade shows (see Appendix B for contact list) **b)** • The assigned CA (the EPA, as proposed above) is formally responsible for ensuring compliance (in Ireland) with the requirements of the Regulation. The CA itself can designate responsibility to other bodies, as discussed in Section 8, which proposes an implementation strategy. Establish a communication and reporting framework so that information is submitted to the LA for onward reporting to the CA and the DEHLG, as necessary, to ensure recovery of ODS for destruction, recycling or reclamation (i.e. to ensure compliance with Article 16(1))

Table 5.6. ***contd***

Article	Situation at the time of reporting	Recommendations
		c) • Assign responsibility to the CA to define minimum qualification requirements. In light of the limited halon use in Ireland at present (identified in this study), it is considered appropriate that information in the guidance document for halon (to be published by the CA) be incorporated into in-house training on the remaining uses allowed, i.e. critical uses. Include requirement in guidance document that records of in-house training are maintained, including issues covered • Require all technical work to comply with the requirements of the *Irish Standards on Safe Handling and Transfer Procedures for Halons* (IS 27201). This standard should be referenced in the guidance document and should be included as a module in any in-house training course **d)** • Report to Commission on defined minimum qualification requirements
Article 16(6) **a)** Report to the Commission on systems established to promote the recovery of used controlled substances by 31 December 2001 and annually thereafter **b)** Report to the Commission on the quantities of used controlled substances recovered, recycled, reclaimed or destroyed by 31 December 2001 and annually thereafter **c)** Report to the Commission on the facilities available for recovery, recycling, reclamation or destruction of used controlled substances by 31 December 2001 and annually thereafter	**a)** No report has been submitted. No systems established at present to promote the recovery of used halons, though contact with industry indicates limited ongoing halon use in Ireland **b)** No reporting carried out at present, though information on the quantities of halon sent out of Ireland to destruction facilities within the EU is available through records of Transfrontier Shipment (TFS) documentation. A system is currently in place whereby the LAs report specified data from TFS documentation to the EPA (the data required are specified by the EPA) as required for the purposes of preparing the National Waste Database **c)** No commercial facilities exist for the recovery of used controlled substances in Ireland. Typically, halon-containing cylinders are removed from fire-protection systems and immediately sent for destruction in the UK or other European country. Halon for disposal is reported to be sent out of Ireland via registered hazardous waste contractors. The EPA maintains data on quantities of waste transferred through records maintained from TFS documentation	**a)** • Publish a Guidance Note, including a list of available disposal contractors, alternatives and details of options for replacement of ODS-containing equipment and in particular to ensure decommissioning of non-critical halon systems and proper management of critical-use systems • Ensure dissemination of Guidance Note (web, trade fairs, workshops, etc.) to relevant sector **b)** • The information required in terms of reporting obligations under Regulation 2037/2000 is already available through TFS documentation. Therefore, it is suggested that in addition to the current reports submitted to the EPA by the LAs, the LAs are also requested to separately note any specific shipments of ODS, and report these separately to the CA **c)** • Report to Commission on current information available and future actions planned

Table 5.6. ***contd***

Article	Situation at the time of reporting	Recommendations
Article 17(1) **a)** Precautionary measures taken to prevent and minimise leaks of controlled substances **b)** Define the minimum qualifications for personnel involved in leak detection **c)** Report to Commission on programmes related to qualification requirements by 31 December 2001	**a)** No measures specified at present for halon users, though Health and Safety Legislation in Ireland on *Safe Handling and Transfer Procedures for Halons* (IS 27201) should aid in minimising leakages **b)** No minimum qualifications defined for personnel involved in leak detection for halon systems **c)** No report submitted at present; however, this report forms part of the reporting requirements to the Commission. Based on information gathered during preparation of this report the number of halon users (and thus the number of personnel involved in system maintenance and leak detection) is small	**a)** • Refer in Guidance Note to techniques for preventing leakage from halon systems (e.g. pressure testing of cylinders) and methods of detection such as manual checks, gas analysers, alarmed pressure gauges **b)** • Assign responsibility to the CA to define minimum qualification requirements. In light of the limited halon use in Ireland at present (identified in this study), it is considered appropriate that information in the guidance document for halon (to be published by the CA) be incorporated into in-house training on the remaining uses allowed, i.e. critical uses. Include requirement in guidance document that records of in-house training are maintained including issues covered • Require all technical work to comply with the requirements of *Irish Standards on Safe Handling and Transfer Procedures for Halons* (IS 27201). This standard should be referenced in the guidance document and should be included as a module in any in-house training course **c)** • Report to Commission on defined minimum qualification requirements
Article 17(2)	Not applicable to halons	

Table 5.7. General gap analysis review (general summary only, not exhaustive interpretation of the Regulation).

Topic	Situation at the time of reporting	Recommendations
Import and export		
a) Authorisation required to export halon to countries outside the EU and also to import from countries outside the EU	**a)** No export or import authorisations held at present, though it is possible that no halons have been imported or exported in recent years	**a)** • Ensure that all critical users are aware of the requirements of the Regulation with regard to import and export. This information should be incorporated into the guidance document for operators in this sector
Supply and use		
a) Critical users must apply to the Commission for exemptions **b)** Storage of halons for export for critical uses must be authorised or operated by the Competent Authority	**a)** Critical users have not applied to the Commission for exemptions. A few critical users were identified but there was not a high level of awareness of the Regulation **b)** No export authorisations held at present	**a)** • Identify potential critical users and inform them of the requirements to seek authorisation for a critical-use exemption under the Regulation and associated reporting • Provide guidance in regard to techniques for preventing leakage from halon systems (e.g. pressure testing of cylinders), and methods of detection such as manual checks, gas analysers, alarmed pressure gauges • It is recommended that the Customs and Excise service be designated as the enforcing authority in relation to the import and export of controlled substances. Customs officers should familiarise themselves with the obligations of the Regulation and participate in occasional Commission-sponsored training as it arises. Furthermore, custom authorities should also be familiar with the UNEP website which provides access to a Training Manual and promotional video specifically aimed at customs officers http://www.unepie.org/ozonaction/library/training/main.html **b)** Confirm critical users do not store halon for export; if they do, CA must authorise storage operation

United Nations Environment Programme, Division of Technology, Industry and Economics OzonAction Programme. UNEP, Paris.

UNEP, 2001. *Eliminating Dependency on Halons. Case Studies.* United Nations Environment Programme, Division of Technology, Industry and Economics OzonAction Programme. UNEP, Paris.

5.6.2. Other useful information

Department of the Environment, Heritage
and Local Government
Customs House
Dublin 1
Tel: 1890 20 20 21
Website: www.environ.ie

Environmental Protection Agency
PO Box 3000
Johnstown Castle Estate
Wexford
Tel: +353 53 60600
Website: www.epa.ie

National Standards Authority of Ireland
Glasnevin
Dublin 9
Tel.: +353 1 8073800
Website: www.nsai.ie

Fire Industry Association of Ireland
Website: www.fireindustry.ie

United Nations Environment Programme
OzonAction Programme
Web: www.uneptie.org/ozonaction

United States Environmental Protection Agency,
Ozone-Depletion website: www.epa.gov/ozone

European Commission Ozone-Depleting
Substances website:
www.europa.eu.int/comm/environment/ods/home/home.cfm

6 Gap Analysis for Methyl Bromide

6.1 Information on Methyl Bromide

Methyl bromide (MB) has been widely used as a fumigant to control a range of pests in agriculture and to disinfect durable and perishable commodities. Its main applications being:

- Treatment of soil prior to planting
- Post-harvest treatment of commodities such as grains, timber, fruit and flowers
- Disinfection of buildings, ships, vehicles and other structures
- Quarantine and preshipment use (QPS).

The vast majority of MB produced is used as a fumigant for pest control. Within Member States, MB has predominantly been used for the protection of tomatoes, strawberries, cucurbit crops, peppers, eggplant, cut flowers and tobacco.

Table 6.1 provides a summary of the key nomenclature used to describe and/or label methyl bromide**.**

UNEP's MB Technical Options Committee calculated that approximately 71,500 tonnes of MB were used worldwide in 1996 (UNEP, 1999), of which around 17,000 were used in Europe. By 2001, the use of MB (excluding QPS purposes) had fallen to 6,362 tonnes in the EU (UNEP, 2002). Around 64% of all MB used is estimated to be released to the atmosphere (UNEP, 1998). The free bromine radical is highly reactive and each bromine atom released from MB has the capacity to destroy 60 times more ozone than an atom of chlorine from CFCs (UNEP, 1998). For this reason, MB production and use has been targeted for phase out.

Due to its powerful curative properties and flexible application, no single direct replacement for MB has been identified. However, a range of alternative technologies is being trialled and adopted with reported success. These are discussed in Section 6.4.7.

QPS use reportedly accounts for 22% (UNEP, 1998) of all MB use worldwide and is exempt from the terms of the Montreal Protocol. However, under EC Regulation 2037/2000, Member States must annually report any QPS use to the Commission and provide information on the progress being made to identify and adopt alternatives.

6.2 Specific Requirements of Regulation 2037/2000

6.2.1 The Regulatory Authority

The Department of the Environment, Heritage and Local Government (DEHLG) is the Regulatory Authority for the implementation of this Regulation. The Competent Authority (or Authorities) for the implementation of the Regulation has not yet been designated in Ireland. The Member States' responsibilities under the Regulation include:

- Provision of information to the Commission on the requirements for the production, import or use of MB for nominated critical usage after 31 December 2004

Table 6.1. Common labelling nomenclature.

Common name	Methyl bromide or bromomethane
Chemical formula	CH_3Br
Trade names	Meth-O-Gas, Bromo-O-Gas, Dowfume Embafume, Terabol, Terr-O-Gas, Haltox
CAS number	74-83-9
UN number	1062
UN hazard class	2.3
CN code (CN 99)	2903 30 33
Harmonised customs code	--2903.30
Risk phrases (SI 77/1994)	R23-36/37/38
Safety phrases (SI 77/1994)	S1/2, 15-27-36/37/39-38-45

- To encourage the development and use of MB alternatives
- To annually report to the Commission on the amount of MB authorised for QPS use, the purposes of MB use, and the progress made in evaluating and adopting alternatives
- To define the minimum qualification requirements for personnel involved in MB application
- To report to the Commission by 31 December 2001 on the programmes implemented to achieve the specified minimum qualification requirements
- To request the Commission to authorise the temporary use of MB in the event of an emergency involving an outbreak of pests or disease most suitable to MB treatment.

6.2.2 Import and export

There are currently no known producers or exporters of methyl bromide in Ireland. However, MB is imported into Ireland from both EU and non-EU countries. (Note that the terms 'import' and 'export' in the context of the Regulation refer to the transfer of MB across the boundaries of the European Union).

The following requirements apply to producers and importers of MB:

- The level of MB produced in 2004 may not exceed 25% of the calculated level produced in 1991 (it is understood that no MB is produced in Ireland)
- The production of MB must cease as of 31 December 2004 (except for critical use)
- A Licence is required for the production, import or export of MB, issued by the Commission (subject to quantitative limitations determined on an annual basis with quotas allocated)
- Export or import of MB may not occur to or from any country that has not ratified the Montreal Protocol.

The use of MB as a plant-protection product comes within the scope of plant-protection product legislation of the Department of Agriculture and Food – principally Statutory Instrument SI No. 83 of 2003, European Communities (*Authorisation, placing on the market, use and control of plant protection products*) Regulations 2003. These Regulations do not provide for the licensing of importers and exporters of MB. The Regulations do require annual returns of quantities imported or exported.

6.2.3 Supply and use

- Any producer or importer of MB is prohibited from placing any MB on the market or using any for its own account after 31 December 2004
- The level of MB placed on the market or used in 2004 by any producer or importer may not exceed 25% of the calculated level placed on the market or used in 1991
- Annually a critical-use exemption/nomination for MB requesting a quota allocation under the Protocol is necessary, together with a Licence issued by the Commission following applications to the Member State.

MB may not be supplied or used by any undertaking after 31 December 2005 unless a critical-use exemption has been granted. This includes any stockpiled material.

The above requirements do not apply to methyl bromide produced or imported for QPS purposes subject to certain limitations as detailed in Article 4(2)(iii) with respect to quantities.

The sale of MB is restricted to persons authorised under the *Poisons Act, 1961*. The issuing and registration of such licenses is undertaken by the Regional Health Boards within the Department of Health and Children.

MB may not be imported and placed on the market after 31 December 2004 or used by any party, other than critical-use exemptions or QPS purposes (subject to Article 4.2(iii) conditions), after 31 December 2005. This includes any stockpiled material. Ireland has applied for a critical-use nomination/exemption (CUN/E) for 2006 for one company on foot of a Commission trawl initiated in July 2004 to determine needs across the EU for critical uses in 2006 and 2007.

Article 16(4) of the Regulation also states that controlled substances shall not be placed on the market in disposable containers, except for essential uses.

6.2.4 Leak detection

Article 17 of the Regulation specifies that:

- All precautionary measures practicable shall be taken to prevent and minimise leakages of MB from

fumigation installations and operations in which MB is used

- Wherever MB is used for soil fumigation, virtually impermeable films (or other techniques providing a similar level of environmental protection) shall be employed to minimise the loss of MB to the atmosphere
- Member States shall define the minimum qualification requirements for the personnel involved.

6.2.5 Certification and training

Article 17 of the Regulation requires that Member States define the minimum qualification requirements for personnel involved in the use of MB. While this has yet to be completed in Ireland, once established, all users must comply with the qualification requirements imposed.

6.2.6 Recovery, recycling and reclamation

Article 16(5) requires that Member States take steps to promote the recovery, recycling, reclamation and destruction of controlled substances and shall assign to users, refrigeration technicians or other appropriate bodies responsibility for ensuring compliance with the provisions of Article 16(1). While these Articles refer specifically to the recovery of controlled substances used in refrigeration, air conditioning, heat pumps, solvent-containing equipment and fire-protection systems, Article 16(3) requires controlled substances contained in products, installations and equipment other than these to be recovered where practicable and treated as provided for in Article 16(1).

Article 17(1) requires that all practicable measure be taken to prevent and minimise leaks of controlled substances.

6.2.7 Disposal and destruction

The restrictions with respect to the placing on the market and import of controlled substances for destruction do not apply where these substances are being used within the Community for destruction by technologies approved by the Parties to the Protocol (Articles 4(4)(i)(a) & 7(d)).

The transport and disposal of waste MB must comply with all relevant national and EU legislation pertaining to the disposal of hazardous waste. This includes:

- *Waste Management (Hazardous Waste) Regulations, 1998*
- *Waste Management (Movement of Hazardous Waste) Regulations, 1998*
- *Waste Management (Transfrontier Shipment of Waste) Regulations, 1998.*

Article 16(6) requires Member States to report on the quantities of used controlled substances recovered, recycled, reclaimed or destroyed annually. In general it is considered that used MB is unlikely to be collected for recycling, reclamation or destruction; hence, this requirement is not likely to be an issue for MB, the only exception potentially being unused MB sent for destruction. Technologies are available/under development for recovery of MB (see Section 6.4.4) particularly in relation to the use of MB in enclosed spaces for QPS purposes; hence, it is possible that the requirements for recovery of MB may change in the future.

6.2.8 Exemptions

The production, export, import, supply and use of MB is exempt from the requirements of the Montreal Protocol, where it is intended solely for the purpose of quarantine and preshipment applications (QPS).

QPS is used to meet the quarantine restrictions and pest-control regulations when importing/exporting goods to certain countries. For example, timber exports to the UK are required to be fumigated with MB prior to shipment.

Articles 4, 7 and 12 of the EC Regulation allow for the establishment of quotas and authorisation for the production, export, import, supply and use of MB for QPS use. These are established by the Commission.

In Ireland there is currently no system in place for the authorisation of methyl bromide use for QPS purposes. Article 4(2)(iii) requires that each year Member States report to the Commission on the quantities of MB authorised for QPS use in their territory, the purpose for which the MB was used, and the progress in evaluating and using alternatives.

There are currently no other exempted categories of MB in Ireland.

6.3 Baseline Analysis

Contact was made with a number of companies involved in the supply or use of methyl bromide in Ireland including:

- Pesticide Control Service of the Department of Agriculture and Food
- Department of Agriculture and Food – Forest Service
- Department of Health and Children – Regional Health Boards
- Central Statistics Office
- Teagasc
- National and International Pest Control Associations
- Irish facilities involved in storage and milling of cereal crops
- Irish Horticultural Development Board (Bord Glas)
- Irish-based pest-control and timber-treatment companies
- Chemical importers, manufacturers and suppliers
- Waste management contractors.

A contact list is included in Appendix C.

6.3.1 Import and export

Annual imports and exports of methyl bromide in plant protection and biocidal products are recorded under legislation for which the Pesticide Control Service (PCS) of the Department of Agriculture and Food is the Competent Authority – European Communities (*Authorisation, placing on the market, use and control of plant protection products*) Regulations, 2003 (SI No 83 of 2003) for plant-protection products and European Communities (*Authorisation, placing on the market, use and control of biocidal products*) Regulations, 2001 (SI No 625 of 2001) for biocides. The requirement to make returns under this legislation is separate from any import/export (across the European Community boundary) requirements under Regulation 2037/2000.

Discussions with the PCS indicated that one product containing methyl bromide is currently authorised under SI No 83 of 2003 as a plant-protection product. The authorisation allows the MB to be used as a plant-protection product only. The PCS indicates that since the system was originally established in the mid-1980s, there have only ever been two companies that held registrations for MB-based plant-protection or biocidal products. No exports have been reported to the PCS.

At the time of the preparation of this report there was only one known importer of MB. Contact with this company and also with pest-control contractors, indicated that this importer supplied MB for all pest-control uses including use in the food industry (e.g. flour mills) and for QPS purposes (e.g. timber packaging). The PCS maintains records of imports and exports of MB in plant protection and biocidal products (i.e. all movements of into and out of Ireland), as these data must be reported to the PCS by registration holders on an annual basis). A summary of imports is provided in Table 6.2. There were no reported exports over the same time period.

However, data obtained from the Irish Central Statistics Office indicate higher volume of MB being imported into Ireland although the CSO has since confirmed that discrepancies have arisen due to misidentification and mislabelling of various plant-protection products as MB at the point of import.

The PCS annually reports pesticide import statistics to both Eurostat and to the OECD (Organisation for Economic Co-operation and Development) for publication. These data are not routinely copied to the DEHLG or to the EPA. The data themselves would be included within a reported pesticide ‘type’ rather than the actual individual quantity of MB imported.

During the course of this study, it was revealed that a number of the pest-control companies act indirectly as MB importers (in this context, imports does not necessarily mean from outside the EU). When required, MB stocks were relocated from their parent companies in Britain and Northern Ireland, to their Irish branches. It is considered that this may be the source of some of the additional MB imports accounted for in the CSO import figures. It was further found that a UK supplier was distributing MB directly to a number of pest-control companies. The UK supplier estimated that approximately 1,295 kg of MB had

Table 6.2. Transfer into Ireland of methyl bromide (PCS data).

Year	Methyl bromide (kg)
1998	32,000
1999	18,200
2000	14,400
2001	23,900
2002	17,900
2003	10,702

been sold directly into the Republic during 2003. It is understood that neither the UK supplier nor the pest-control companies report these imports to the Department of Agriculture and Food Pesticide Control Service.

6.3.2 Supply and use

MB is classified as a poison under the *Poisons Act, 1961* (Schedule 1, as enacted in SI No 188 of 1982). The Competent Authority for licensing of the sale of MB under the Act is the Department of Health and Children. This responsibility is devolved to each of the Regional Health Boards. Contact with the Boards indicates that a central registration of all poisons licences is not maintained and the information is not in the public domain.

Therefore, potential MB suppliers were identified through a review of the Golden Pages and discussions with industry associations (see Appendix C). Over 100 companies involved in the manufacture, distribution or use of agricultural chemicals were contacted during the survey. Only one company (Cedele) confirmed that they routinely supply MB to the Irish market. It is understood that they supply MB to a number of pest-control companies.

A list of potential MB users in Ireland was compiled from information from MB suppliers, the Irish Pest Control Association (IPCA), the PCS and the NSAI (see Appendix C). Over 20 companies were contacted during the survey. Only three companies confirmed they routinely used MB, a fourth had ceased using it in 2002. Typical uses reported by these facilities includes use in flour mills/bakeries, bulk fumigation of milk powder, fumigation of wood products prior to export and fumigation of wood products at ports where the wood has not been treated in their country of origin. These companies also indicated limited use of MB in agricultural/horticultural applications. This list is not considered definitive as there are no licensing, permitting, record-keeping requirements or other restrictions identified for the general use of MB.

As MB carries a number of toxic risk phrases (R23-36/37/38), the use of MB in the workplace is covered under the *Chemical Agents Regulations 2001*. While this Regulation does not provide specific guidance on the handling or application of MB, it does require the conduct of a risk assessment and the implementation of any controls deemed necessary to protect the user and the public.

One specific use was identified where registration was required – the use of MB for the fumigation of wood packaging under the *International Standard for Phytosanitary Measures (IPSM) No 15*. IPSM 15 prescribes the requirements for the export of wood products to certain countries, including the use of MB fumigation. At the time of reporting, there were two Irish companies registered to use MB under IPSM 15. A current list of registered companies is available at www.agriculture.gov.ie. Responsibility for the implementation of IPSM 15 is given to the Forest Service (Department of Agriculture and Food). Registration and auditing of the participating companies is undertaken by the National Standards Authority of Ireland (NSAI).

Contact with MB users indicated that the application of MB as a fumigant is undertaken in accordance with the manufacturer's instructions and general good practice operating procedures. An example is included in Appendix H.

Of note, the Pesticides Control Service has recently commissioned an annual survey of the application of pesticides in Ireland. The survey will seek to compile data regarding the application of individual pesticides (including MB), by crop and by region (i.e. the survey concentrates on agricultural end-users). The first survey results will be available at the end of 2004 and will provide a cross-reference for the CSO and PCS import data. Note that this survey will not identify any MB used for QPS or other non-crop related applications.

6.3.3 Training and certification

There are currently no legislative requirements for staff operating with MB to receive training in MB use or MB alternatives. As part of the study, contact was made with the Department of Agriculture and Food, Department of Health, Teagasc and the Irish Pest Control Association (IPCA). All contacts confirmed that there were no specific courses or qualifications available for users of MB in Ireland. However, as part of the Rural Environment Protection Scheme (REPs), Teagasc run a number of relevant courses, including:

- Pesticide application
- Safe use of pesticide products.

These documents provide general guidance on best practice for application and use of pesticides for farmers working within the REPs scheme.

The BPCA (British Pest Control Association) of which the IPCA (Irish Pest Control Association) is a subsidiary, provides a series of 1-day and 5-day training courses in fumigation technology, including reference to the use of MB. Successful participants receive a BPCA Fumigation Diploma or Certificate of Proficiency, respectively.

Contacts within industry indicate that the majority of training is conducted in-house, although in some cases, the course outlines had been approved by the BPCA/IPCA. However, there were no training courses identified that dealt specifically with MB use or MB alternatives. (Where provided, it was included as part of a general fumigation topic.) Contact with one Irish operator within the pest-control industry in Ireland indicated that personnel involved in the use of MB had completed the BPCA general training course, which included information in relation to the use of MB.

As the phase-out programme for MB is nearing completion, the imposition of a formal training scheme and minimum qualifications for personnel involved in MB use may not be practical at this time.

6.3.4 Recovery, recycling and reclamation

Discussions with industry contacts indicate that MB is unlikely to be recovered in any application in Ireland.

6.3.5 Disposal and destruction

All transfrontier shipments of waste should be accompanied by the required TFS (Transfrontier Shipment) documentation under the Waste Management (Transfrontier Shipment of Waste) Regulations, 1998. This documentation is forwarded to the relevant Local Authority. The Local Authority then forwards summary information from this document to the EPA in the format specified by the Agency for the purpose of maintaining national statistics on the export of waste.

Discussions with a number of hazardous waste disposal contractors indicate that none of these contractors had been involved in the collection or disposal of MB or used MB containers. It is anticipated that all MB imported into Ireland is used, with any residue being dispersed to the atmosphere.

Discussions with industry contacts indicate that the used MB containers are typically returned to the suppliers.

6.3.6 Critical use

Discussions with industry contacts indicate that some are considering applying for a critical-use exemption prior to MB use being phased out (i.e. for use after 31 December 2004). The potential critical uses cited include the fumigation of food products and grain silos.

Under the Regulation the use of methyl bromide for Quarantine and Pre-Shipment (QPS) applications is allowed to continue (beyond the usage cessation deadline defined for other MB applications of 31 December 2005) subject to the receipt of authorisation from the Member State.

In Ireland there is currently no system in place for the authorisation of methyl bromide use for QPS purposes, though contact with MB users indicated that MB is currently used for QPS purposes. Article 4(2)(iii) requires that each year Member States report to the Commission on the quantities of MB authorised for QPS use in their territory, the purpose for which the MB was used, and the progress in evaluating and using alternatives.

6.4 Best Practice Measures

6.4.1 Import and export

The import and export of MB into/out of the European Community requires an authorisation from the Commission under Regulation 2037/2000. It is the responsibility of the importer/exporter to apply to the Commission. Application forms may be found on the EU website (www.europa.eu.int/comm/environment/ods/index.htm) and should be directed to:

Ozone Layer Protection
European Commission
Directorate – General Environment
Unit ENV.C.2 – Climate Change
B 1049 Brussels
Fax: + 32 22 99 8764
E-mail: env-ods@cec.eu.int

If approved, the Commission will allocate a portion of the available MB quota (calculated as per Article 3), to the applicant for import. A copy of the import licence will be sent to the Competent Authority of the Member State. The application must be renewed each year and data on the amount of MB imported into Ireland must be reported annually to the Commission.

A copy of the application should also be sent to the Member State's Regulatory Authority. In Ireland this is:

Air/Climate Section
Department of the Environment,
Heritage and Local Government
Customs House
Dublin 1
Ireland

No import quotas were granted to Irish companies for 2004, suggesting that MB used in Ireland is sourced from within the EU. For 2004 the Commission granted MB-import quotas totalling 4,580,980,000 ODP kg to ten companies within the EU.

The import into Ireland or export from Ireland of MB in plant protection or biocidal products is required to be reported annually to the PCS, as detailed in Section 6.3.1.

6.4.2 Supply and use

In many countries MB is classified as a 'restricted-use' pesticide and may only be supplied to registered users. Registration is typically controlled by the relevant State Agencies. In Ireland, the sale of MB is regulated under the *Poisons Act, 1961* and any company involved in the sale of MB must hold a Licence from the local Regional Health Board. In some countries (e.g. USA, Canada), the management of data regarding the supply and use of MB is further improved by the establishment of a central national register. This has not been undertaken in Ireland and reliable data on MB suppliers were difficult to compile.

In addition, many countries require all MB users to keep records of the amounts of chemical used and to report annually to the relevant authority. (In the USA this is referred to as the Federal Pesticide Record Keeping Program.) There is currently no requirement in Ireland for MB users to record the amounts consumed. However, the import quantities reported annually to the PCS are likely to be a reasonable representation of the quantities used annually in all applications as the data are submitted to the PCS by the only authorised MB distributor in Ireland (authorised under the '*Authorisation, placing on the market, use and control of plant protection products regulations*, 2003 (SI No 83 of 2003)), and do not relate only to application in pre-harvest applications of MB but to all MB applications. The PCS figures will not, however, include any unauthorised imports of MB (e.g. from Northern Ireland or the UK). Ireland will be required to report to the Commission annually on the quantities of MB authorised for QPS use, the purposes for which they were used and progress in evaluating and using alternatives. A system must be put in place to ensure that these data are available for reporting to the Commission.

Guidance on the application of MB is available from the product manufacturers (an example is included in Appendix H). These documents typically include information on:

- Storage and handling
- Application techniques for different situations
- Leak prevention
- Monitoring
- Health and safety precautions
- Recommended dose rates for various applications.

In spite of the technical difficulties associated with the recovery of MB, action is still required to minimise its release to the atmosphere during use. In particular, the Regulation specifies:

- All precautionary measures practicable shall be taken to prevent and minimise leakages of MB from fumigation installations and operations in which MB is used
- Wherever MB is used for soil fumigation, virtually impermeable films (or other techniques providing a similar level of environmental protection) shall be employed to minimise the loss of MB to the atmosphere.

The use of virtually impermeable films holds the MB gas in contact with the soil for longer. This means that the dose rates can be substantially reduced, further minimising the release of MB to the atmosphere.

Use of MB will be allowed only for QPS purposes after 31 December 2005. From 31 December 2004, producers and importers are not allowed place MB on the market or use any for its own account. Use of MB for QPS purposes must be authorised by the Member State under the requirements of the Regulation. In Ireland there is currently no specific system in place for the authorisation of methyl bromide use for QPS purposes. Article 4(2)(iii) requires that each year Member States report to the

Commission on the quantities of MB authorised for QPS use in their territory, the purpose for which the MB was used, and the progress in evaluating and using alternatives. In order to provide this detail it is considered that a registration and reporting system will need to be set up, obliging all users to register for QPS authorisation and to report annually on quantities used and the purpose of the use and any alternative products used for QPS purposes.

6.4.3 Training and certification

Training of technicians and users in the safe handling and use of any pesticides is vital. In Ireland, the IPCA provides training in pesticide use, with successful participants attaining an IPCA Diploma. However, the course does not cover the use of MB. There were no Irish-based institutions identified that provide training specifically in the use or phase out of MB. Teagasc also include modules in their training courses; however, the use of MB for QPS purposes (the only expected future use of MB in Ireland) is not covered in these courses.

The use of MB under IPSM 15 (i.e. for QPS purposes related to fumigation of wood packaging) is controlled by the Forest Service. Training in MB use is required as part of the IPSM Registration process; however, there are no suggested course outlines and no minimum qualifications established. Discussions with the registered MB users under this scheme, indicate that the training is largely in-house and that there are no external qualification requirements. Registered users of MB must be approved (by an audit process) by the NSAI. Discussions with these users indicated that no recovery of MB is carried out.

Examples of broader MB training programmes are available in the UK. The *UK Control of Pesticides Regulation (COPR) 1986* restricts the supply of MB to operators that can demonstrate that they have the necessary competency and experience to use it safely. The BPCA has developed a training and certification course to meet the requirements of both the COPR and ODS Regulations.

In the USA and Canada, the supply and use of MB is restricted to Certified Applicators or persons under their direct supervision. Training and certification is provided by the State Agencies.

UNEP have also run a series of demonstration projects and workshops in the use and phase out of MB based technologies. Successful participants receive a Certificate of Competency. The courses have predominantly been held in developing countries, (there have been none provided in Ireland). Further details regarding training in the use and phase out of MB (links to course outlines, workshop and conference proceedings) are included in Appendix E.

Contact with MB users during this study indicates very limited use of MB for agricultural/horticultural purposes and with other uses being in the food industry (mills/bakeries) and for QPS purposes. Based on this limited use the following training qualification requirements are suggested as being suitable for expected future MB use in Ireland:

- The NSAI Registration scheme for IPSM 15 could be expanded to include all users (i.e. all companies offering fumigation services using MB) of MB to ensure that minimum standards are in operation by these users. By the end of 2005 this is expected to include only use for QPS purposes; thus, the companies that will require such certification are likely to be already registered with the NSAI. A small number of companies (expected to be less than 10) may need to go through the registration process (though the possibility of registration under the same scheme for companies not involved in MB use for forest-product/wood-packaging applications must be investigated in conjunction with the NSAI)

- The Diploma Course run by the IPCA should be expanded to include a module on the use of methyl bromide for QPS purposes. Individuals who have already completed the course should be able to attend this module only. Information on MB usage could also be included in Teagasc courses related to pesticide usage

- All in-house training should refer to available guidance documents (see Section 6.6).

6.4.4 Recovery, recycling and reclamation

The dispersion of MB gas into a space is prerequisite in its use as a fumigant. As a result, approximately 60% of all MB used is released to the atmosphere as part of the application process.

Due to the nature of the process, the recovery (and hence the subsequent recycling or reclamation) of MB is

reported by users to be economically unfeasible and is not commonly practised in Ireland.

In addition, recovered MB may be deemed unsuitable for reuse on food products, due to the potential for cross-contamination.

Technologies are available for recapture/recovery of methyl bromide using carbon beds or proprietary adsorbtion/absorbtion systems to remove (scrubber systems) methyl bromide from the air drawn out of a fumigation enclosure. These systems appear to be employed mainly in the USA and have not been employed to date in Ireland. One example of use in the USA was in a fumigation enclosure at an airport.

6.4.5 Disposal and destruction

Any residual stockpiles of MB held after 31 December 2005 must be disposed of in an appropriate manner. The material may be disposed as a waste or transferred as a raw material to certain countries (listed in Article 5(1) of the Montreal Protocol) where its use under quota is permitted until 2015, or used for QPS purposes or for sanctioned critical-use nominations/exemptions. Any company intending to export (to a country outside the Community) excess stocks of MB from Ireland will require authorisation from the Commission. QPS use must be authorised by the Member States and nominations for critical-use exemptions after 31 December 2004 will be decided by the Commission for submission to UNEP.

Waste MB (and potentially used MB containers) would be considered a hazardous material and are subject to the requirements of the relevant EU and Irish waste-management legislation including:

- *Waste Management (Hazardous Waste) Regulations, 1998*
- *Waste Management (Movement of Hazardous Waste) Regulations, 1998*
- *Waste Management (Transfrontier Shipment of Waste) Regulations, 1998.*

Any MB intended for disposal (including unused raw material) must be disposed of with a licensed hazardous waste contractor. A list of licensed contractors is available on the Irish EPA website (www.epa.ie).

The following provides a listing of the technologies acknowledged as being suitable for use in the destruction of ODS:

- Liquid injection incineration
- Reactor cracking
- Gaseous/fume oxidation
- Rotary kiln incinerators
- Cement kilns
- Radio frequency plasma destruction technology.

While having no legislative basis, the use of these technologies was agreed at a Meeting of the Parties to the Montreal Protocol. As none of these technologies are currently licensed for the disposal of hazardous wastes in Ireland, all MB stockpiles not used by 31 December 2005 (other than that intended for QPS use), must be exported for destruction. The party disposing of the waste must maintain the appropriate records of disposal for a minimum of 7 years.

6.4.6 QPS use

It can be difficult to determine whether a particular MB application qualifies as QPS use and may therefore be allowed under both the Protocol and the ODS Regulation. Figure 6.1 (UNEP, 1999) provides a decision tree to assist users and regulatory authorities to assess each application and determine the correct classification.

6.4.7 Alternatives to methyl bromide

There has been significant progress in the development of alternatives to MB, although no single direct replacement has yet been identified. UNEP and other interest groups, strongly endorse the use of 'Integrated Pest Management', which promotes the integration of a variety of practices, non-chemical alternatives and new chemicals to achieve satisfactory pest control.

Tables 6.3 and 6.4 provide a summary of a range of alternative chemicals and processes commonly being adopted to replace a variety of MB applications (Methyl Bromide Technical Options Committee, 1998). These alternatives are currently being promoted by UNEP's Methyl Bromide Technical Options Committee; however, the list is in no way considered definitive. Each alternative must be adapted to suit the individual application and in some cases, a combination of methods and chemicals

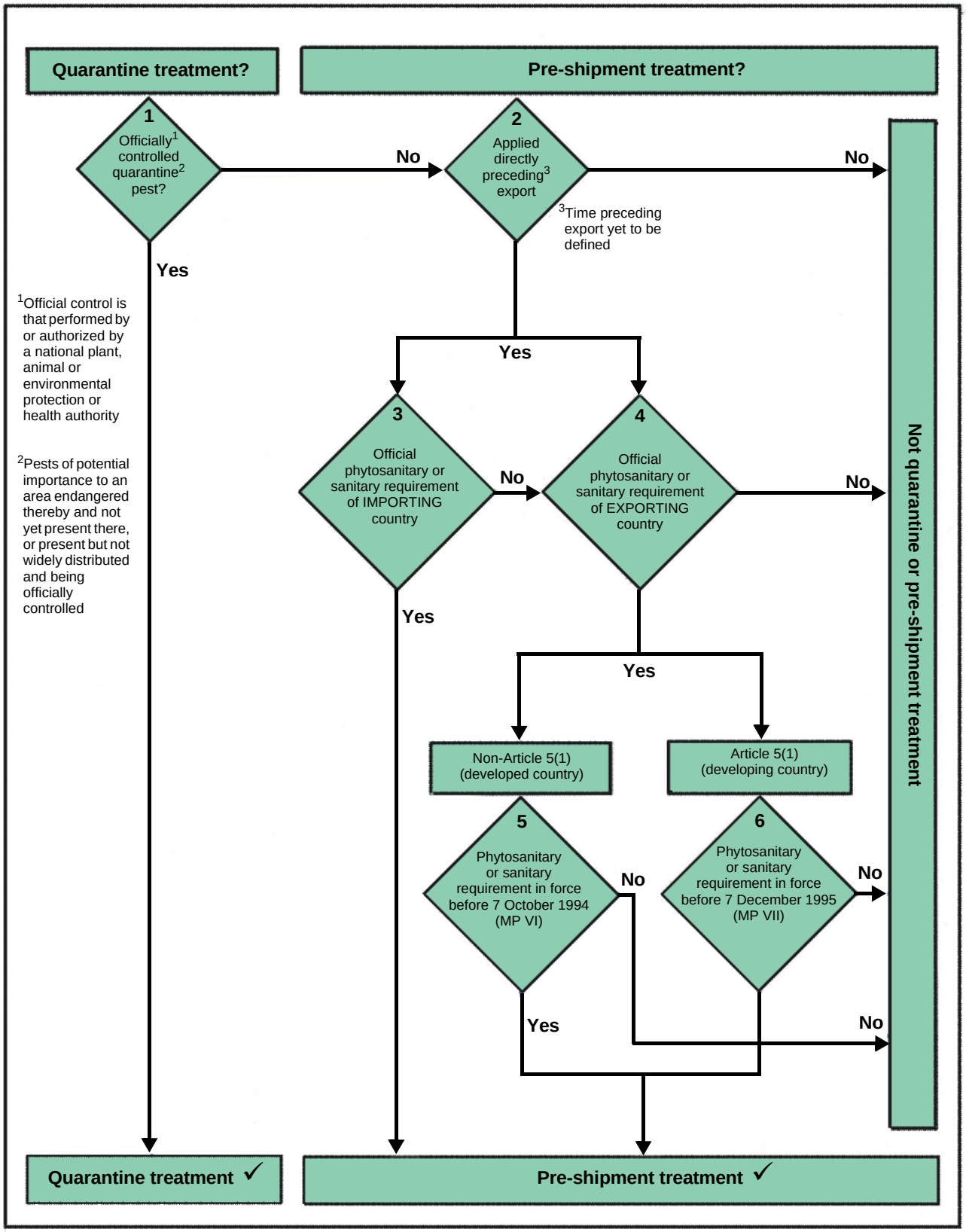

Figure 6.1. QPS determination (from UNEP, 1999).

Table 6.3. Summary of alternatives for post-harvest uses of MB (Methyl Bromide Technical Options Committee, 1998).

Alternatives for post-harvest uses of MB	Carbon dioxide	Ethylene oxide	Phosphine	Proplyene oxide	Sulfuryl fluoride	Sulphur dioxide	Aerosol pesticide formulations	Contact insecticides	Dichlorvos	High-pressure water	Inert dust/earth	Pyrethroids	Pheromones	Physical removal	Preservatives	Rodenticide
Durables (general)								X			X	X				
Artefacts			X					X	X							
Coffee, tea and cocoa	X			X				X			X					
Cereals and grain	X							X	X		X	X	X			
Cotton			X													
Dried fish and meats								X								
Dried fruit and nuts	X		X										X			
Grains (general)			X					X	X		X	X	X			
Rice	X		X					X			X	X				
Wheat	X		X					X				X				
Herbs and spices	X	X		X												
Pulses			X					X			X	X				
Seeds (for planting)			X				X					X		X		
Timber products	X				X			X							X	
Tobacco			X					X				X				
Perishables							X		X					X		
Cut flowers							X		X	X		X				
Fresh fruits						X	X			X						
Vegetables							X									
Structures								X			X	X	X			X
Flour mills													X			
Transport	X								X							X
Freight containers			X													
Other vehicles			X													

Table 6.4. Summary of alternatives for pre-plant use of MB (Methyl Bromide Technical Options Committee, 1998).

Alternatives for pre-plant use of MB	1,3-Dichloropropene	1,3-Dichloropropene, brush burning	1,3-Dichloropropene, chloropicrin	1,3-Dichloropropene, chloropicrin, metam sodium	1,3-Dichloropropene, chloropicrin, pebulate	1,3-Dichloropropene, metam sodium	Basamid	Chloropicrin	Sodium tetrathiocarbonate	Metam sodium	Metam sodium, chloropicrin	Metam sodium, crop rotation	Metam sodium, solarisation	Nematicides	Solarisation, fungicides
Nursery (general)		X	X	X		X	X	X		X					
Strawberries – runners			X	X		X									
Forest tree nursery							X			X					
Tobacco seedlings		X	X				X	X		X					
Strawberries – fruit	X		X	X				X		X	X			X	
Curcubits (general)	X							X		X				X	
Cucumber												X			
Melon												X			
Squash												X			
Solanaceous crops (general)	X		X					X		X		X		X	X
Tomato	X		X		X			X		X		X			X
Pepper	X		X					X		X		X			X
Root crops													X		X
Other vegetable crops														X	
Onion													X		
Peas												X			
Ornamentals (general)	X		X			X		X		X	X	X			
Rose	X					X				X					
Fruit and nut trees	X		X			X				X				X	
Banana	X		X							X				X	
Citrus	X													X	
Vineyard									X						
Stone fruit	X														
Sod/turf							X								

may be required. The potential for chemical tolerance or resistance in the local insect/pest population to the alternatives is also a critical factor when selecting a treatment method. The inclusion of these data does not represent a recommendation of a particular MB alternative, and all alternatives should be scrutinised closely to ensure no other adverse impacts such as impact on local watercourses or wildlife.

All MB users are strongly recommended to contact their suppliers and/or industry associations to discuss their specific circumstances. There is also a large body of research available regarding the application of MB alternatives, both within the EU and elsewhere. This is most commonly in the form of:

- Data from research trials
- Demonstration projects
- Training workshops
- Conference proceedings.

Further information on the application and efficacy of the alternatives for different applications is available from the references listed in Section 6.6.

Training and awareness-raising activities have a central role in the promotion of MB alternatives. The sharing of hands-on local knowledge is considered vital, as the efficacy of many MB alternatives can be significantly affected by regional variations in soil conditions, temperature, etc. Training in the correct use of the alternatives will also help avoid chemical tolerances developing in the insect/pest communities.

The Euro-Retailers Produce Working Group has developed a series of *Eurepgap Standards* which aim to provide a system of global agricultural standards (Eurepgap Standards, 2002). The Group also provides a framework to provide quality certification to produce suppliers and retailers. The *Eurepgap Fruit and Vegetable Standard* mandates that all use of MB be justified and recorded, and promotes the production of crops without MB. While these Standards currently have no legislative bearing, they are being voluntarily implemented by the produce industry in over 35 countries. Under the Standard, data on MB use are typically copied to the relevant section within the Department of Agriculture and Food. Bord Glas (Horticultural Development Board) operate a quality assurance scheme for fruit and vegetable growers, though this does not specifically deal with the quantities or types of pesticides used on crops.

One of the most common constraints to the implementation of MB alternatives is cited as being the high cost of obtaining registration for a new chemical, or to adapt the use of an existing chemical or system (e.g. heat treatment). While in the case of alternative chemicals this cost is largely borne by the chemical manufacturers and suppliers, it has reportedly inhibited the development and marketing of alternatives for use on food products.

Suppliers and users of MB alternatives must ensure that the chemicals selected are registered for use in Ireland. This is particularly relevant where the substance is to be applied to food stocks. For example phosphine, an alternative fumigant, has been widely registered for many purposes but not for use on foods. Studies are in progress in relation to other alternatives such as heat treatment and combinations of treatments using heat and chemicals such as pure phosphine or carbon dioxide or combinations of these.

UNEP has published a document detailing the most environmentally friendly available alternatives for methyl bromide, *Case Studies on Alternatives to Methyl Bromide – Technologies with Low Environmental Impact.* A number of other useful documents, as detailed in Section 6.6, provide information on alternatives to methyl bromide in a range of applications. Several documents detailing alternatives for methyl bromide can be downloaded from the UNEP website at:
http://www.uneptie.org/ozonaction/library/tech/main.htm

6.4.8 Implementation and incentives

Economic instruments

A number of feasible economic instruments can be employed, including:

- Subsidies or tax reductions for non-ODS products, equipment or technology
- Changes in excise and sales tax, e.g. impose higher duties on ODS products
- Provide funding for research into non-ODS alternatives to MB.

Legislation

Applicable legislative incentives include:

- Prepare legislation for implementation of a registration and reporting scheme for MB importers, suppliers and users. Clear and comprehensive custom codes will also aid in tracking movements of MB into and out of the country

- Impose a certification system, so that only those who fulfil certain requirements are allowed to use MB for pest-control purposes.

Voluntary approaches

The provision of training and technical advice is essential in the adoption of MB alternatives, as most of the new techniques and chemicals require a different set of skills to ensure their effective use. Skills transfer may occur in a variety of ways including:

- Demonstration Projects

- Technology Transfer Projects

- Train the Trainer

- Farmer Field Schools.

Each of these dissemination techniques has been proven to be effective in countries trialling MB alternatives. A number of workshop proceedings and training manuals documenting these programmes are provided in the references in Section 6.6.

- The promotion of eco-labelling, e.g. 'MB Free', for certain items, particularly food products

- The supply of promotional materials regarding the phase out of MB to all identified (and suspected) MB suppliers and users.

6.5 Summary Gap Analysis and Recommendations

Table 6.5 provides a summary of the gap analysis for Articles 16(5), 16(6), 17(1) and 17(2) as they pertain to the control and use of methyl bromide in ireland.

Table 6.6 provides a summary of the gaps identified in the current systems in place to control the use and phase out of methyl bromide in Ireland, outside the scope of these Articles; however, this should not be considered a comprehensive gap analysis of the complete Regulation. Suggested recommendations are also made based on international best practice measures identified during the study.

6.6 References and Useful Information

6.6.1 References

UNEP, 1998. *Methyl Bromide – Getting Ready for Phase Out*.

UNEP, 1999. *Towards Methyl Bromide Phase Out. A Handbook for National Ozone Units*.

UNEP, 2002. Regional Workshop on *Methyl Bromide Alternatives in Eastern and Central Europe*.

International Conference on *Alternatives to Methyl Bromide*, Seville, 2002

Methyl Bromide Technical Options Committee, 1998. *Technically Feasible Options for Controlling Pests*.

Eurepgap Standards, 2002. *Promoting safe and Sustainable Agriculture Including Alternatives to Methyl Bromide.*

6.6.2 Other useful information

UNEP, 1999. *Inventory of Technical Resources for Promoting Methyl Bromide Alternatives.*

UNEP, 2001. *Sourcebook of Technologies for Protecting the Ozone Layer: Alternatives to Methyl Bromide*.

UNEP, 1999. *Twenty Case Studies on Alternatives to Methyl Bromide*.

Canadian Pest Management Authority, 1998. *Integrated Pest Management in Food Processing – Working Without Methyl Bromide*.

CSIRO, 1995. *Agricultural Production Without Methyl Bromide*.

BIRC, 1996. *Integrated Pest Management – Alternatives to Methyl Bromide*.

6.6.3 Links

- UNEP Ozone Action Programme
  www.unepie.org/ozonaction.html

- Sustainable Agriculture Directory
  www.agnic.org/agdb/sustagex.html

- Agricultural Research Service
  www.ars.usda.goz/is/mb/mebrweb.html

- Pesticide Action Network
  www.panna.org/panna/campaigns/mb.html

- European Commission's Responses to FAQs
  www.europa.eu.int/comm/environment/ozone/faqs.htm

Table 6.5. Summary of gap analysis for Articles 16(5), 16(6), 17(1) and 17(2) for methyl bromide.

Article	Situation at the time of reporting	Recommendations
Article 16(5) **Article 16(6)** **Article 17(1)**	Not applicable to methyl bromide	**General recommendation** In order to effectively implement the legislation the first measure required would be the designation of a Competent Authority (CA) by the DEHLG. It is recommended that the EPA is the most appropriate CA for this Regulation. It is also recommended that the Department of Agriculture and Food is the most appropriate enforcement body for MB (see Section 8). The CA and the enforcement authority should focus in the first instance on addressing areas of non-compliance as identified in this report, on the detailed recommendations herein, and prioritise reporting to the Commission using the agreed reporting format
Article 17(2) **a)** All precautionary measures to be taken to prevent and minimise leakages of methyl bromide from fumigation installations and operations **b)** Virtually impenetrable films must be used during soil fumigation **c)** Define the minimum qualification requirements for personnel involved	**a)** There were no fumigation installations (i.e. purpose-built facilities for fumigation of materials) identified in Ireland. This report identifies minimal quantities of methyl bromide currently used in operations in Ireland and in these cases relevant precautionary measures are being taken. The survey did not identify any formal guidance on this topic. Teagasc has general guidance on good farming practice and there are modules within the Rural Environmental Programme (REPs) scheme in relation to pesticide application and safe use of pesticide products, though none of these deal specifically with MB usage. The Irish Pest Control Association (IPCA) also run a diploma course in pesticide use, though again this does not deal specifically with MB **b)** Soil fumigation is rarely conducted in Ireland. VIF has reportedly been used where appropriate. **c)** Minimum qualifications have not been defined and there are no formal training programmes available in Ireland on fumigation using methyl bromide. Teagasc has a general training course in relation to pesticide application and the safe use of pesticides in agriculture. The IPCA also runs a diploma course on pesticide use though neither this nor the Teagasc course deals specifically with MB usage. The National Standards Authority of Ireland (NSAI) operate a Registration Scheme for companies involved in phytosanitary treatment of wood packaging. Three companies are reported to be registered to use methyl bromide for this purpose. These companies are audited by the NSAI for the purposes of ongoing registration. Other pest-control companies (not registered by NSAI) employ in-house training or use training provided by suppliers	**a)** Publish Guidance Note for methyl bromide incorporating techniques for preventing leakages of MB during fumigations including compliance with the manufacturer's instructions. Review Teagasc Code of Practice and training courses developed by Teagasc under the REPs scheme for *Pesticide Application* and *Safe Use of Pesticide Products* and adapt if suitable/necessary for future QPS and critical-use exemptions It may also be possible to add a module to the IPCA diploma course in relation to the use of MB for QPS purposes **b)** The effective use of these films should to be referred to in the Guidance Note and should be covered in training courses. It should be stated that such use requires a critical-use exemption from the Commission **c)** Assign responsibility to the CA to define minimum qualification requirements. Expansion of the NSAI registration scheme to cover all companies involved in MB fumigation is a possible method of ensuring minimum qualification standards for MB users (see Section 6.4.3). The inclusion of a module on MB usage in the IPCA diploma on pesticide usage could also be considered in forming part of a certified training programme for MB users. In addition, the inclusion of a module on MB usage in pesticide training modules offered by Teagasc could also meet training requirements in relation to the pre-harvest application of MB in agriculture and horticulture. Consideration should also be given to using material from the UNEP website, which provides a large volume of training manuals and promotional material aimed at the phase out of MB which could be adapted to suit the situation in Ireland. http://www.unepie.org/ozonaction/library/training/main.html

Table 6.6. General gap analysis (general summary only, not exhaustive interpretation of the Regulation).

Topic	Situation at the time of reporting	Recommendations
Import and export Article 6/7 of the Regulation	**a)** Imports/exports are controlled under a Licence system administered by the Commission as per EC 2037/2000. The Licence must be renewed each year. To date, no import quotas have been requested by Irish companies **b)** Plant protection and biocidal products (including those that contain MB) must be registered with the Pesticide Control Service (PCS) of the Department of Agriculture and Food before they can be placed on the market in Ireland under the 'European Communities (*Authorisation, placing on the market, use and control of plant protection products*) Regulations, 2003' (SI No. 83 of 2003) for plant-protection products and the 'European Communities (*Authorisation, placing on the market, use and control of biocidal products*) regulations, 2001' (SI No. 625 of 2001) for biocides **c)** It was reported that MB – not registered with the Department of Agriculture and Food – was imported into Ireland from within and from outside the EU **d)** Imports have on occasion reportedly been misidentified and mislabelled as MB, resulting in discrepancies between the data compiled by the Central Statistics Office and the Pest Control Service	**General recommendations** • It is recommended that the current systems controlling the import and export of methyl bromide in Ireland be strengthened, to increase the level of awareness of the control dates within the Regulation. It is suggested that promotional information be developed aimed at potential MB importers, suppliers and users that specifies the requirements of the Regulation in plain language. This information should be incorporated into the guidance document for operators in this sector. • It is recommended that the Customs and Excise service be designated as the enforcing authority in relation to the import and export of controlled substances. Customs officers should familiarise themselves with the obligations of the Regulation and participate in occasional Commission-sponsored training as it arises. Furthermore, custom authorities should also be familiar with the UNEP website which provides access to a Training Manual and promotional video specifically aimed at customs officers http://www.unepie.org/ozonaction/library/training/main.html
Supply and use Article 4 of the Regulation	**a)** The supply and sale of MB is regulated under the *Poisons Act, 1961*, with Licences issued by the Regional Health Boards. There is currently no centralised register of Licensed outlets or record of MB sales, and it was not possible to confirm the number of sales outlets in Ireland **b)** The use of MB is not directly regulated under Irish law (other than peripherally through the *Chemical Agents Regulations 2001, The authorisation, placing on the market, use and control of biocidal products regulations 2001* (SI No. 625 of 2001) and *The authorisation, placing on the market, use and control of plant protection products regulations 2003* (SI No. 83 of 2003)), and there are currently no usage-reporting requirements **c)** The Pest Control Service has implemented an annual survey which will document the use of MB (and other plant-protection products) **d)** The use of MB for QPS purposes is not regulated other than in relation to the IPSM 15 standard. The current study was not able to determine how much MB was being used for QPS and by whom	The assigned Competent Authority (the EPA, as proposed above) is formally responsible for ensuring compliance (in Ireland) with the requirements of the Regulation. The CA itself can designate responsibility to other bodies, as discussed in Section 8, which proposes an implementation strategy. Establish a communication and reporting framework so that information on quantities of MB authorised use purpose (QPS, critical-use exemptions) and evaluation of alternatives can be collected by the CA for reporting. A licensing system for fumigators should be established for critical uses to enable the critical-use exemption stock to be drawn down from the Commission website controlling critical uses in the EU. Furthermore, a management plan for such uses needs to be developed and submitted to the Commission, in the first instance by June 2005 to allow 2006 critical-use exemptions

Table 6.6. ***contd***

Topic	Situation at the time of reporting	Recommendations
Disposal and destruction General considerations related to Article 16	**a)** There are no licensed commercial disposal outlets for MB or empty MB containers in Ireland. Any unwanted stock must be exported for destruction **b)** Discussions with hazardous waste contractors indicate that to date, there have been no unwanted stocks of MB disposed **c)** Residual stockpiles of MB which remain after the phase-out date must be disposed of in an appropriate manner	**a)** Ireland has the necessary waste legislation and systems in place to allow the export of redundant ODS to facilities, which can dispose of them in an environmentally safe, effective manner **b)** Any stocks of methyl bromide authorised for QPS use cannot be reallocated for other purposes (i.e. critical uses). The use of MB other than for QPS use requires a critical-use exemption. In 2005, the situation in relation to these other stocks is under review by the Commission and therefore any reallocation of stocks (e.g. for critical uses) must be agreed with the Commission because it will impact on critical-use exemptions granted for 2006
Promotion of MB phase out and use of alternatives Article 4(2)	**a)** The survey did not identify any formal or government-sponsored awareness-raising campaigns aimed at promoting the phase out of MB or the use of alternatives in Ireland. However, the phase out of MB appears to be occurring at a satisfactory rate, with a steady decline in MB imports observed **b)** All industry contacts approached during this study were aware of the existence of the Regulation and the requirement to phase out non-critical MB use. There was limited awareness regarding the stages and dates of the phase-out programme, and few of the contacts had knowledge of how to apply for a critical-use exemption **c)** Contacts had limited awareness of where to go for further information, with most relying on information provided by their suppliers	**a)** Given the proximity of the phase-out date and the general level of awareness observed during the course of this study, a widespread awareness-raising campaign is not considered appropriate or necessary. However, a focussed campaign aimed initially at the contacts identified through this study, could prove beneficial. It is suggested that information be provided regarding: • Phase-out dates • Licensing and registration requirements, including how and where to apply and any new initiatives • Record-keeping and reporting requirements, including any new initiatives; • How to apply for critical-use exemptions • Where to go for information on alternatives • What to do with unwanted stocks of MB Furthermore, the relevant authorities should be promoting the investigation of alternatives to methyl bromide in all cases (i.e. QPS and critical uses)
QPS use	**a)** The use of MB for QPS purposes is allowed under the requirements of the Regulation. However, the Regulation requires that the Competent Authority report annually to the Commission on the amount of MB used for QPS purposes, and the progress made in evaluating and adopting alternatives. This is not currently done. It is noted that the amount of MB used for QPS would be captured as part of the total volume of MB imported into Ireland, although these data do not distinguish 'import' from 'use'	**a)** The assigned CA (the EPA, as proposed above) is formally responsible for ensuring compliance (in Ireland) with the requirements of the Regulation. The CA itself can designate responsibility to other bodies, as discussed in Section 8, which proposes an implementation strategy. Establish a communication and reporting framework so that information on quantities of MB authorised use can be collected by the CA for reporting

7 Gap Analysis for Solvents

7.1 Information on Solvents

Many types of ODS have been used as solvents, including CFC-113, 1,1,1-trichloroethane, carbon tetrachloride, bromochloromethane and HCFCs. In this context the term 'solvent' is used for convenience, as a collective term for a wide variety of applications, as solvents in its literal meaning, for other cleaning applications, for de-greasing, as carriers for lubricants, for drying and etching, as adhesives, for coating, as process agents, etc. ODS traded as solvents (in this broad sense) are often mixed with a small portion of other chemicals to make them better adapted for their specific application, with different trade names depending on the detailed composition.

The use of these compounds as solvents is banned (including use of stockpiled materials) under the requirements of Regulation 2037/2000; however, they may continue to be used as a feedstock or a processing agent. A temporary exemption (until 31 December 2008) also exists for the precision cleaning of electrical and other components in aerospace and aeronautics applications. Nonetheless, summary information on these compounds are presented in the following paragraphs.

In the past, CFC-113 use was essential in many industrial applications: in electronic assembly production processes, precision cleaning and general metal degreasing during manufacture, as well as in dry-cleaning and other industrial applications. CFC-113 began to be used in the 1970s in metal degreasing and other areas owing to concern, particularly in the United States and Japan, over the toxicity of the chlorinated solvents used previously (UNEP, 2001). Its use in other sectors followed, contributing to a rapid growth of the CFC-113 market, which reached 178,000 tonnes a year in 1986.

A number of HCFC compounds have been used as solvents, the most common of which is HCFC-141b (dichlorofluoroethane). Other HCFCs used as solvents include HCFC-225ca and HCFC-225cb (two different isomers of dichloropentafluoropropane). These compounds have been employed in many cases as a substitute for the more traditional solvents such as 1,1,1-trichloroethane.

1,1,1 Trichloroethane (also known as methyl chloroform) has been widely used as a versatile all-purpose solvent. It was introduced in the mid-1950s as a cold cleaning solvent substitute for carbon tetrachloride, with other historical uses including:

- Vapour degreasing
- Cold cleaning of fabricated metal parts and other materials
- Fluoropolymer synthesis, as a solvent
- Adhesive and aerosol formulations
- Certain coatings and inks formulations
- Variety of textile applications
- Dry-cleaning leather and suede garments.

Carbon tetrachloride is a highly toxic compound which was formerly used for metal degreasing and as a dry-cleaning fluid, fabric-spotting fluid, fire-extinguisher fluid, grain fumigant and reaction medium, in addition to other historical uses such as:

- Solvent for the recovery of tin in tin-plating waste
- Manufacture of semiconductors
- Petrol additives
- Refrigerants
- Metal degreasing
- Catalyst in the production of polymers
- Chemical intermediate in the production of fluorocarbons and some pesticides.

Bromochloromethane (also known as chlorobromomethane) has its primary use as a feedstock in the manufacture of biocides within enclosed systems. Around 150–225 tonnes per annum are reported to be used for this purpose in the UK. It has also been historically used in fire extinguishers and other applications including:

- Degreasing agent
- Organic synthesis
- Reaction solvent.

General information on the compounds detailed above are presented in Table 7.1.

ODS solvents have been widely used due to their many favourable properties including (note that all these properties are not applicable to all of the above solvents):

- Low toxicity
- High solvency
- Low flammability
- Relatively high stability
- Low boiling point
- Low solubility in water.

7.2 Specific Requirements of EC 2037/2000

7.2.1 The Regulatory Authority

The Department of the Environment, Heritage and Local Government (DEHLG) is the Regulatory Authority for this Regulation. The Competent Authority (or Authorities) for the implementation of the Regulation has not yet been designated in Ireland. Member States responsibilities under the Regulation include:

- Promotion of the recovery, recycling, reclamation and destruction of controlled substances. Member States must report to the Commission annually on the systems established to promote the recovery of used controlled substances, the facilities available and the amount of solvent recovered, recycled, reclaimed or destroyed
- Encourage the development and use of solvent alternatives
- Define the minimum qualification requirements for personnel involved in ODS solvent related applications
- Report to the Commission by 31 December 2001 on the programmes implemented to achieve the specified minimum qualification requirements
- Require the use of technologies approved by the Parties to the Montreal Protocol or other environmentally acceptable technology for the recovery and destruction of equipment containing solvents, or for recycling or reclamation during

Table 7.1. General information on ODS solvents.

Common name	1,1,1-Trichloroethane	Carbon tetrachloride	CFC-113	HCFC-141b	HCFC-225ca	HCFC-225cb	Bromochloro-methane
Chemical formula	$C_2H_3Cl_3$	CCl_4	$C_2F_3Cl_3$	$C_2H_3FCl_2$	$C_3HF_5Cl_2$	$C_3HF_5Cl_2$	CH_2BrCl
Synonyms	Methyl chloroform	Carbon tetrachloride	1,1,2-Trichlorotrifluoro ethane	Dichlorofluoro ethane	Dichloropenta fluoropropane	Dichloropenta fluoropropane	Bromochloro-methane Chlorobromo-methane Methylene-chlorobromide
CAS number	71-55-6	56-23-5	76-13-1	1717-00-6	422-56-0	507-55-1	74-97-5
UN number	UN 2831	UN 1846	–	–	–	–	UN 1887
UN hazard class	6.1	6.1	–	–	–	–	6.1
CN code (CN 99)	2903 1910	2903 1400	2903 4300	2903 4900	2903 4900	2903 4900	2903 4980
ODS potential	0.1	1.1	0.8	0.11	0.025	0.033	0.12
Risk phrases (SI 77/1994)	R20-59	R-23/24/25-40-48-52/53-59	R59	R52/53/59	Not available	Not available	R36/37/38
Safety phrases (SI 77/1994)	S2-24/25-59-61	S1/2-23-36/37-45-59-61	S9/44	S59/61	Not available	Not available	S 36/37/39

servicing and maintenance, or before the dismantling or disposal of equipment

- Authorise production for the purpose of meeting essential uses for which licences have been issued by the Commission and notify Commission in advance (Article 3(5)) and license ODS used for inward processing relief under Article 6(2).

7.2.2 *Imports and exports*

The terms 'import' and 'export' are defined under the Regulation as the movement of goods across the boundaries of the European Union, as opposed to national boundaries.

The Regulation does not include any specific requirements in relation to the import or export of ODS solvents into Ireland from within the European Union.

There are currently no known producers or exporters of ODS solvents in Ireland. Exports are reported in Table 7.3 though it is considered that this may be related to re-export of previously imported material. However, 1,1,1-trichloroethane and carbon tetrachloride are imported into Ireland both from within the EU and from external sources (see Section 7.3) (Table 7.2). Imports of controlled substances are prohibited unless authorised under licenses issued by the Commission for use as feedstock or as processing agents, or for essential or critical uses, or if they are imported for destruction.

The importation and placing on the market of products and equipment containing ODS solvents from outside the EU is prohibited. Products and equipment covered under processes in which controlled substances are used as processing agents (Annex VI of the Regulation), for feedstock uses, or critical-use exemptions and products and equipment manufactured before entry into force of the Regulation (1 October 2000) are an exception.

Exports from the EU of 1,1,1-trichloroethane, carbon tetrachloride and bromochloromethane or products and equipment, other than personal effects, containing those substances or whose continuing function relies on supply of those substances is prohibited. Export of these substances is still allowed for the purposes of feedstock and processing-agent applications. HCFC export is still allowed, but only to States which are subject to the Montreal Protocol.

Import/export authorisation (for example for use as a feedstock or processing agent) must be sought from the Commission and the authorisation is valid for 1 year (the quantity to be exported is detailed in the authorisation).

Table 7.2. Imports of 1,1,1-trichloroethane, carbon tetrachloride, bromochloromethane and CFCs (CSO data).

	1998	1999	2000	2001	2002
1,1,1–Trichloroethane	1222 kg	2861 kg	219,018 kg	9271 kg	955,792 kg
Carbon tetrachloride	105 kg	900 kg	–	45 kg	160 kg
Bromochloromethane	No data	No data	No data	59,183 kg	36,403 kg
CFC-11	0	393,551	275,278	347,303	173,396
CFC-12	21,673	43,600	529,404	541,072	1,171,277
CFC-113	181	554	547	594	64
CFC-114	28	117	80	0	105
CFC-115	429	0	0	0	0
CFC-13	71,964	65,274	53,697	71,046	38,952
CFC-111	0	0	0	0	0
CFC-112	0	220	0	30	0

Table 7.3. Exports of 1,1,1-trichloroethane, carbon tetrachloride and CFCs (CSO data).

	1998	1999	2000	2001	2002
1,1,1–Trichloroethane	–	–	–	–	3,826 kg
Carbon tetrachloride	–	–	–	–	–
Bromochloromethane	–	–	–	–	–
CFC-11				720 kg	
CFC-12			1,571 kg		

The Commission has set up a web-based ODS Declaration System to simplify the authorisation process. This can be accessed at:
http://europa.eu.int/comm/environment/ods

No import licences for use as a feedstock were requested by Irish companies in 2003. Quotas were issued last year to companies in the Netherlands, Spain and Denmark.

Import of controlled substances or products and equipment containing controlled substances from any State not party to the Montreal Protocol is prohibited.

7.2.3 Supply and use

A complete ban on trade and use of ODS solvents came into force on the 1 October 2000. With respect to the use of HCFCs as solvents the ban came into effect from 1 January 2002 with the exception of precision cleaning of electrical and other components in aerospace and aeronautics applications where the prohibition shall enter into force on 31 December 2008. The trade ban applies to all sources of material, including recovered and recycled solvent. The definition of use includes use for topping up and maintaining equipment but does not include use as a feedstock or processing agent. Article 16(1) requires that controlled substances in equipment containing solvents be recovered for destruction, recycling or reclamation. Therefore, any equipment still containing ODS solvents should be decommissioned and the solvent recovered.

The placing on the market and the use of these solvents shall be prohibited, with the exception of products and equipment for which the use of the solvent has been authorised. Any authorisations for essential solvent use must be made by the Member State to the Commission on behalf of any undertaking within the Member State.

Ireland has not applied for any critical-use exemptions (e.g. such as laboratory use). Therefore, ODS solvents may not be used by any party, other than for the exempted purposes (e.g. use as a feedstock or processing agent). This includes the use of any stockpiled material.

7.2.4 Certification and training

Article 16 requires that Member States shall define minimum requirements for those involved in recovery, recycling, reclamation and destruction of controlled substances. The Regulation also requires that Member States report to the Commission on the programmes put in place to meet the above requirements by 31 December 2001.

Article 17 of the Regulation requires that all precautionary measures practicable shall be taken to prevent and minimise leakages of controlled substances. Member States shall define the minimum qualification requirements for the personnel involved, and report to the Commission by 31 December 2001 on the programmes put in place in relation to these qualification requirements. While this has yet to be completed, when implemented, all users must seek to comply with these qualification requirements.

7.2.5 Recovery, recycling and reclamation

Article 16(5) requires that Member States shall take steps to promote the recovery, recycling, reclamation and destruction of controlled substances and shall assign to users, or other appropriate bodies, responsibility for ensuring compliance with the provisions of Article 16(1). These Articles refer specifically to the recovery of controlled substances contained in refrigeration, air conditioning, heat pumps, fire-protection systems, fire extinguishers and equipment containing ODS solvents. Article 16(3) requires controlled substances contained in products, installations and equipment other than these to be recovered if practicable.

Regulation 2037/2000 defines recovery, recycling and reclamation as follows:

- *Recovery* is the collection and the storage of controlled substances from, for example, machinery, equipment and containment vessels during servicing or before disposal
- *Recycling* is the reuse of a recovered controlled substance following a basic cleaning process such as filtering and drying.
- *Reclamation* is the reprocessing and upgrading of a recovered controlled substance through such processes as filtering, drying, distillation and chemical treatment in order to restore the substance to a specified standard of performance, which often involves processing off-site at a central facility.

Article 4 of the Regulation states that the placing on the market and use of CFCs, bromochloromethane, carbon tetrachloride and 1,1,1-trichloroethane are prohibited; hence, any still in use in equipment should be destroyed, reclaimed or recycled in line with the requirements of the Regulation. Any HCFCs still in use as solvents (with the exception of precision cleaning in aerospace and

aeronautics applications (as detailed in Article 5(1)(b)(ii)) should also be recovered for reuse in other HCFC (e.g. refrigeration) applications or for destruction or reclamation.

Articles 17(1) and 17(3) require that all practicable measure be taken to prevent and minimise leakages of controlled substances used as feedstock and processing agents, and from equipment containing solvents. Businesses can recover spent solvents through the use of an outside recycler, or recycle solvents on-site using their own equipment (see Section 7.4.4 for best practice options on recovery, recycling and reclamation).

7.2.6 Disposal and destruction

Waste ODS solvent is considered a hazardous material and is subject to the requirements of the relevant EU and Irish waste management legislation including:

- *Waste Management (Hazardous Waste) Regulations, 1998*
- *Waste Management (Movement of Hazardous Waste) Regulations, 1998*
- *Waste Management (Transfrontier Shipment of Waste) Regulations, 1998.*

Any ODS intended for disposal (including unused raw material) must be disposed through a licensed hazardous waste contractor. A list of licensed contractors is available on the EPA website (www.epa.ie). The most likely disposal route will be high-temperature incineration. As there are currently no licensed incinerators accepting off-site waste in Ireland, all ODS solvent waste must be exported for destruction. The party disposing of the waste must maintain the appropriate records of disposal for a minimum of 7 years.

7.2.7 Exemptions

Article 7 of the Regulation allows for the establishment of quotas for the import of ODS solvents for feedstock or processing-agent use. The Commission issues these quotas on an annual basis to companies who have applied to the Commission for an import quota. Details of the quotas are issued annually and the methods for application for an import quota can be accessed on the Europa ODS website:
http://europa.eu.int/comm/environment/ods.

Article 3 of the Regulation states that licences may be granted for the use of banned controlled substances under exceptional circumstances. It is understood that no such licences have been issued to companies in Ireland; hence, any ongoing use of ODS solvents, except for use as a feedstock or processing agent, should cease immediately.

The Regulation allows for exemptions for processes in which ODS solvents are used as processing agents – these are detailed in Annex VI and include processes such as:

- The use of carbon tetrachloride for the elimination of nitrogen trichloride in the production of chlorine and caustic soda
- The use of carbon tetrachloride for the recovery of chlorine in tail gas for production of chlorine
- The use of carbon tetrachloride in the manufacture of chlorinated rubber
- The use of carbon tetrachloride in the manufacture of isobutyl acetophenone (ibuprofen analgesic)
- The use of carbon tetrachloride in the manufacture of polyphenyleneterephtalamide
- Use of CFC-113 in the manufacture of vinorelbine (pharmaceutical product)
- Use of CFC-113 in the reduction of perfluoropolyetherpolyperoxide intermediate for production of perfluoropolyether diols with high functionality
- The use of carbon tetrachloride in the production of tralomethrine (insecticide).

Article 5(1)(b)(ii) also allow HCFCs to be used as solvents in the precision cleaning of electrical and other components in aerospace and aeronautics applications where the prohibition shall enter into force on 31 December 2008.

Any requirements for essential laboratory use of ODS solvents must be authorised by the Commission on an annual basis. The Commission will then issue quotas to these users and inform them of the uses for which they have authorisation. If the material cannot be sourced from inside the Community the user must then apply for an import authorisation.

The Commission has also allowed solvent use for laboratory applications, and a number of companies applied for laboratory-use exemptions for 1,1,1-trichloroethane, carbon tetrachloride and bromo-chloromethane for 2004. In total 21 European companies were granted quotas for carbon tetrachloride, 19 for CFC use (though no specific breakdown is provided for CFC-113), nine for 1,1,1-trichloroethane and three for bromochloromethane. No quotas were assigned to Irish based companies. Under Article 5(2)(a) the use of HCFCs for laboratory applications is also allowed.

7.3 Baseline Analysis

7.3.1 Import and export

The import and export of 1,1,1-trichloroethane and carbon tetrachloride are regulated under the Council Regulation (EEC) No. 2455/92, amended by EC Regulation 304/2003. The regulation concerns the export and import of certain dangerous chemicals, which are banned or severely restricted in the EU. The Designated National Authority (DNA) responsible for importation and exportation under this Regulation, with regard to these chemicals in Ireland, is the Hazardous Substances Assessment Unit (HSAU) of the Health and Safety Authority which is responsible for the implementation of this regulation with regard to industrial chemicals, whilst the Pesticide Control Service of the Department of Agriculture and Food is responsible for the implementation of the Regulation with regard to plant-protection products.

The Regulation ensures that exports of chemicals banned or severely restricted within the Community are subject to a common notification and that chemicals are exported at least 6months before their expiry date. The regulation (Article 14(2)) also bans the export of certain chemicals to countries within the Community. Exports of the chemicals detailed in the Regulation to countries outside of the Community are packaged and labelled to at least the standard of those placed on the market in the Community. At the time of this report there were no known Irish exporters of 1,1,1-trichloroethane, carbon tetrachloride or bromochloroethane. The 1,1,1-trichlorethane and CFC exports noted in Table 7.3 were from Ireland to the UK.

The European Chemicals Bureau (ECB) of the European Commission has developed the database EDEXIM (European Database of EXport and IMport of certain dangerous chemicals), which includes an electronic transfer facility to register import/export of restricted chemicals under Regulation (EEC) 304/2003.

Import and export data from the Irish Central Statistics Office are presented in Tables 7.2 and 7.3. The data include imports from countries both within and external to the EU, though as stated above, the exports noted in Table 7.3 were to the UK. As noted in Section 7.3.2, the magnitude of imports in recent years appears to have increased, despite an apparent minimal level usage in Ireland. However, it is considered that this large import figure for 2002 in Table 7.2 may be due to misclassification of other imported materials.

7.3.2 Supply and use

Contact made with industry as part of this study indicated that ODS solvents are still in use. Out of approximately 100 companies involved in the manufacture, distribution or use of chemicals no users were identified; however, two companies confirmed that they supply 1,1,1-trichloroethane to the Irish market, and one company confirmed supplying carbon tetrachloride. They supply small user laboratories and third-level institutions. Data from the Central Statistics Office (CSO) indicate that suppliers import from EU countries in all but two cases. HCFC is still supplied and used for refrigeration purposes and import information is not separated into refrigeration/solvent use. CFC use is allowed only under specific critical-use exemptions as detailed Section 4 or for use as a feedstock or processing agent. Import data from the CSO indicate imports of a number of CFCs including CFC-11, -12, -113, -114 and -13 over the last number of years. CFC-11 and CFC-12 are known to be imported by an authorised critical user (see Section 4). The remaining material may be used as a feedstock or processing agent, though no details on the importers of the material could be divulged by the CSO.

CSO data indicate that there has been a large increase in demand for ODS solvents (1,1,1-trichloroethane, carbon tetrachloride, bromochloromethane) in recent years (Table 7.2). However, this is not reflected by the fact that only two suppliers and no users were identified during the course of this study (see Appendix F) and there have been no applications from any sector for critical uses. It is considered that this large import figure for 2002 in Table 7.2 may be due to misclassification of other imported materials which have been wrongly classified as 1,1,1-trichloroethane.

7.3.3 Training and certification

The Regulation requests that Member States define the minimum qualification requirements for anyone involved in the recovery, recycling, reclamation or destruction of ODS solvents. These qualification requirements have yet to be defined in Ireland for personnel working with ODS solvents or equipment containing ODS solvents. Once implemented, all personnel will be expected to obtain the relevant qualifications.

Contact with industry in Ireland has indicated that no formal training is involved with the use or handling of solvents; any training is carried out in-house with no external certification of the qualifications obtained.

There are currently no legislative requirements implemented for staff operating with ODS solvents to receive specific training in their use or alternatives.

There are currently no courses existing in Ireland which deal specifically with the use or safe handling of ODS solvents or of equipment containing ODS solvents. As the phase-out programme for these solvents is practically complete, the imposition of a formal training scheme and minimum qualifications for personnel involved in ODS solvent use may not be practical at this time. As ODS solvents carry a number of toxic risk phrases (R20-59, R-23/24/25-40-48-52/53/59), their use in the workplace is covered under the *Chemical Agents Regulations, 2001*. While the Chemical Agents Regulations do not provide specific guidance on the handling or application of ODS solvents, they require that a risk assessment is conducted and controls are implemented to protect the user and the public. They also specify Occupation Exposure Limits (OELs). The Health and Safety Authority is the Competent Authority for workplace safety and it has issued guidance documents in relation to safe use of chemicals generally (see http://www.hsa.ie).

A few guidelines by organisations, such as the EPA and Enterprise Ireland, have been published, which focus in general on industrial sectors that utilise solvents. The EPA guide for the dry-cleaning sector details a maintenance checklist and the records that should be kept. This set of guidelines can be obtained from the EPA website www.epa.ie.

Enterprise Ireland adapted a document from Envirowise UK, which encourages companies to act voluntarily to use solvents wisely. In this way it's believed that a company can become more competitive while at the same time reducing its VOC emissions. The *Good Housekeeping Measures for Solvents* guide, takes the process down to the implementation level and provides information on a wide range of practical measures. This guide can be downloaded from the Enterprise Ireland website http://www.envirocentre.ie. It is recommended that this document is referred to for guidance in ODS solvent use and disposal.

Cork County Council in conjunction with the Clean Technology Centre has produced a manual on *How to prevent Waste Emissions from your Company*. This is a self-help workbook prepared as an aid to Irish industry in its efforts to achieve sustainable production. The guide encourages the changeover from solvent-based to water-based materials and gives practical advice as to which areas of industry this is applicable.

7.3.4 Recovery, recycling and reclamation

All transfrontier shipments of waste should be accompanied by the required TFS (Transfrontier Shipment) documentation under the *Waste Management (Transfrontier Shipment of Waste) Regulations, 1998*. This documentation is forwarded to the relevant Local Authority. The Local Authority then forwards summary information from this document to the EPA in the format specified by the Agency for the purpose of maintaining national statistics on the export of waste.

On-site recovery is likely to be of limited benefit to the small-scale users in Ireland. The requirements of steam for desorption, cooling, solvent separation and purification of solvent and water streams, as well as not being economically viable, is likely to be outside the experience and capabilities of most small enterprises.

Discussions with industry contacts indicate that ODS solvents are unlikely to be recovered in any application in Ireland. Disposal as a hazardous waste is the typical route for waste solvent.

7.3.5 Disposal and destruction

All transfrontier shipments of waste should be accompanied by the required TFS (Transfrontier Shipment) documentation under the *Waste Management (Transfrontier Shipment of Waste) Regulations, 1998*. This documentation is forwarded to the relevant Local Authority. The Local Authority then forwards summary information from this document to the EPA in the format

specified by the Agency for the purpose of maintaining national statistics on the export of waste.

The EPA would therefore have information on waste solvents sent outside of Ireland for disposal, though data specifically for ODS solvents are unlikely to be available. In addition, there are a number of licensed incinerators (licensed by the EPA) in Ireland (particularly in the pharmaceutical industry) which are used for disposal of waste material generated on-site (i.e. not commercial facilities) and which therefore may incinerate ODS solvent waste generated at the site. Information on quantities of materials disposed of in this manner would also be forwarded to the EPA by the relevant companies; however, specific data on ODS solvent destruction are unlikely to be available.

7.3.6 Exempted use

There are certain temporary exemptions from the use ban for HCFC solvents. These are for precision cleaning of electrical and other components in aerospace and aeronautics applications. For these exempted applications the use ban enters into force on 31 December 2008. The use of HCFCs is also permitted in laboratory uses, as feedstock and as a processing agent.

Article 4(4)(i)(b) also permits the placing on the market and use of ODS solvents if they are used for feedstock or as a processing agent, or if they are used to meet licensed requests for critical uses (e.g. laboratory use).

There are currently no applicants for critical-use exemptions for ODS solvent use in Ireland.

7.4 Best Practice Measures

7.4.1 Import and export

The import and export of ODS solvents into/out of the European Union requires an authorisation from the Commission under Regulation 2037/2000. It is the responsibility of the importer/exporter to apply to the Commission. Application forms may be found on the EU website (www.europa.eu.int/comm/environment/ods/index.htm) and should be directed to:

Ozone Layer Protection
European Commission
Directorate – General Environment
Unit ENV.C.2 – Climate Change
B 1049 Brussels
Fax: + 32 22 99 8764
E-mail: env-ods@cec.eu.int

If approved for import, the Commission will allocate a portion of the available ODS solvent quota (calculated as per Article 7) to the applicant for import. The application must be renewed each year and data on the amount of ODS solvent imported into Ireland must be reported annually to the Commission. The reporting role is currently performed by the DEHLG. Article 11 indicates the conditions under which export of controlled substances is allowed, while the requirement for an authorisation to export these substances is detailed in Article 12, including the details required to be included with the application. There are no known exports of ODS solvents from Ireland to countries outside the Community, as such exports would typically be carried out by producers, with no known producers of these substances in Ireland.

A copy of the application should also be sent to the Member State's Regulatory Authority. In Ireland this is:

Air & Climate Section
Department of the Environment
and Local Government
Customs House
Dublin 1
Ireland

The import and export of ODS solvents is allowed only under limited circumstances as detailed in Articles 7–10 (imports) and Articles 11/12 (exports).

7.4.2 Supply and use

Some US states have enacted *The Halogenated Solvent Users Registration Act*. The law specifies that it is unlawful for any person to distribute, sell, or offer for sale within the State quantities of 20 gallons or more of a halogenated solvent annually, unless the purchaser possesses proof of registration. It further specifies that it is unlawful for any person to annually use 20 gallons or more of a halogenated solvent for commercial purposes without registration.

Enterprise Ireland published a *Good Housekeeping Measures Guidance for Solvents*. The document includes information on:

- Storage and handling
- Employee training and awareness
- Delivery

- Processing
- Health and safety precautions
- Solvent auditing.

This document should be promoted by the Competent Authority as a guide to industry, particularly those who may still be using ODS solvents (as feedstock for example).

The consumption of chlorinated solvent and emission levels from processes are controlled under the *Solvent Emissions Directive 1999/13/EC* also known as the VOC (Volatile Organic Compounds) Directive. The VOC Directive applies to all cleaning processes that utilise chlorinated solvents including the dry-cleaning industry and the metal degreasing industry. It is an obligation of the VOC Directive that an inventory of chlorinated solvent used in cleaning operations is maintained.

Companies licensed under the EPA Integrated Pollution Control (IPC) licensing system are obliged to implement measures to minimise solvent usage and use less harmful solvents if possible. This would include a large number of pharmaceutical companies which may use ODS solvents. Strict limitations are imposed as part of the licence with regard to emissions of solvents from process vents and also fugitive emissions.

The Commission has published a proposal for a Regulation to introduce new controls on many chemical substances manufactured, imported or used within the European Union. REACH, which will be phased in, concerns the **R**egistration, **E**valuation, **A**uthorisation and restriction of **CH**emicals, in certain quantities. It will replace existing EU controls on chemicals.

Its aim is to protect human health and the environment as part of the European Community's chemicals policy, while maintaining a competitive and innovative chemicals industry in Europe.

The Commission proposal can be accessed at: http://europa.eu.int/comm/enterprise/chemicals/chempol/whitepaper/reach.htm

The proposal could have implications for manufacturers, importers and users of a wide range of chemical substances, preparations and articles. It will oblige them to manage the risks from chemicals and to provide safety information on them. This is considered the best practice approach and should be promoted within industry.

The proposed Regulation has been submitted to the Council of Ministers and the European Parliament for decision. The Department of Enterprise, Trade and Employment is co-coordinating the Irish position on the proposal, in co-operation with the Department of Environment, Heritage and Local Government and other relevant Departments.

7.4.3 Certification and training

Training of technicians and users in the safe handling and use of any hazardous solvents is vital. In Ireland, there are no specific courses or training on the use or safe handling of ODS solvents.

The IPC licensing system in Ireland requires that those operatives in IPC-licensed facilities with the potential to impact the environment through their operations should be suitably trained with regard to managing and minimising environmental impacts, though no one specific training course is recommended or operated by the EPA.

The UK has issued a number of guidance notes in relation to ODS solvents, their use, and safe handling.

The Health and Safety Executive (HSE) in the UK issued an information sheet listing the main guidance notes and manuals available on health and safety issues relating to solvent use in degreasing and cleaning operations. The references are from both HSE and other sources. These guidance documents are useful as guidance notes and should be applied to practices in Ireland.

Some of the guidance notes available from the HSE are:

- Guidance from the National Physical Laboratory
- Guidance from the Environmental Technology Best Practice Programme
- Guidance from solvent suppliers
- Guidance from equipment suppliers
- Guidance from British Standards Institute
- Guidance specific to degreasing from the HSE.

The information sheet can be viewed on the HSE website www.hse.gov.uk or can be downloaded as a pdf file: http://www.hse.gov.uk/pubns/eis22.pdf

There have been a number of guidelines and resource modules issued by organisations, DEFRA (UK), the

USEPA and the UNEP. The guidelines in general focus on industrial sectors that utilise ODS solvents.

DEFRA/DTI (UK)

- http://www.dti.gov.uk/access/guidozone.htm
- Phase out of Ozone Depleting Solvents – Advice on Alternatives and Guidelines for Users of CFC, HCFC and 111-Trichloroethane: DEFRA/DTI.

UNEP OzonAction Programme 2001

- http://www.uneptie.org/ozonaction/library/main.html
- ODS Import/Export Licensing Systems Resource Module: Phasing Out ODS in Developing Countries
- Protecting the Ozone Layer, Volume 2: Solvents, Coatings And Adhesives
- Protecting the Ozone Layer, Volume 5: Aerosols, Sterilants, Carbon Tetrachloride and Miscellaneous Uses
- How Small and Medium Sized Enterprises in Developing Countries can Protect the Ozone Layer
- Maintaining Military Readiness by Managing Ozone Depleting Substances: Guidelines for Armed Forces in Developing Countries.

USEPA/ICEL

- Alternative Solvents Manuals
- Manuals produced by USEPA's Stratospheric Protection Division and the Industry Cooperative for Environmental Leadership http://www.epa.gov/spdpublc/title6/snap/icel/icel.html.

Chlorine Online Information Source has published a set of guidance documents on the VOC Directive (1999/13/EC) for chlorinated solvent users. This document has been produced in order to help users of chlorinated solvents to use them in accordance with the requirements of the VOC Directive. These guidelines can be accessed via www.eurochlor.org and may be adapted to focus purely on the use of ODS solvents.

The European Commission has also set up an information exchange website, run by the University of Karlsruhe and created in order to provide focused information for all users affected by the EU Solvent Directive. This may also be adapted for use solely in relation to ODS solvents.

Enterprise Ireland adapted a document from Envirowise UK, which encourages companies to act voluntarily to use solvents wisely. In this way it's believed that a company can become more competitive while at the same time reducing its VOC emissions. The *Good Housekeeping Measures for Solvents* guide, takes the process down to the implementation level and provides information on a wide range of practical measures. This guide can be downloaded from the Enterprise Ireland website http://www.envirocentre.ie.

It is recommended that this document (in addition to the documents referenced above) is referred to for guidance in ODS solvent use and disposal and should be employed in all in-house training courses.

7.4.4 Recovery, recycling and reclamation

If solvents cannot be eliminated from the process, the second option is to recycle or reuse the wastes that are generated in an environmentally sound manner (waste minimisation). It must be remembered that there are only limited allowed uses of ODS solvents as identified in Article 4(4)(i). Businesses can recover spent solvents though the use of an outside recycler, or recycle solvents on-site using their own equipment. Before a company purchases any solvent-recycling equipment it needs to consider possible limitations. These limitations include:

- the cost of purchasing and maintaining recycling equipment
- the cost of training and staffing equipment operators
- will the amount of spent solvent recycled justify the costs of recycling?
- potential fire and/or explosion hazard
- is the final product of the recycling process usable in the original process?
- regulatory considerations for air emissions and bottoms disposal .

Some industrial solvents are blends of two or more pure solvents and additives. Recycling could alter the solvent's composition and usefulness. 1,1,1-Trichloroethane, for example, can break down during distillation and become acidic. By-products of the industrial process may also prevent recycling. Stabilisers and/or other additives may be required in order to make the recycled product usable. Suspended solids affect the efficiency of the recycling

apparatus and limit which types of recycling units can be used.

The quality of the distilled product of the recycling process needs to be considered as some recycled solvents may not be usable for their original purpose. It may not be necessary to recycle a solvent to 100% purity for an intended purpose. Additives may be necessary for a solvent to be safe and effective for an industrial process

There are three general solvent still types as detailed in Table 7.4.

If the suspended solids content is high, additional equipment may be necessary to facilitate distillation in addition to cleaning. Solvents with very high boiling points may require reduced pressures to be distilled; a vacuum can be used to reduce the distillation pressure. The risk of fire hazards or explosions that are possible in some stills, can be reduced with the use of a vacuum unit.

Another important consideration is the air emissions of the still and/or the recycling process. Air emissions from a distillation process are regulated in two forms: fugitive emissions and point-source emissions. Fugitive air emissions are leaks in the unit, or emissions from the recycling process, opening the unit, filling the unit, cleaning the unit, etc. Point-source air emissions would be emissions via a ventilation stack. The design of most modern stills should limit the amount of solvent which is released into the air in vapour form during operation.

There are a number of commercially available solvent recycling systems. However, they are only suitable for medium- (194 litres/ week) to large-scale users (255 litres/ week). However, there are a number of laboratory solvent recovery systems that can be adapted to recycle a number of solvents. See Becca (supplier of solvent recovery systems) website: http://www.beccainc.com/solvent.htm

UNEP will be publishing *Guidelines regarding the Establishment of Recovery and Recycling Systems and Related Legislation for Low Volume Countries*. These guidelines are recommended as guidance to industry. A copy of these will be available on their website www.uneptie.org/ozonaction.

7.4.5 Loss minimisation during use

The Enterprise Ireland *Good Housekeeping Measures for Solvents* guide takes the process down to the implementation level and provides information on a wide range of practical measures to prevent solvent loss during use, transfer and storage. This guide should be referenced during any in-house training for technicians, in particular in relation to minimising loss during storage of ODS solvents and can be downloaded from the Enterprise Ireland website http://www.envirocentre.ie.

In spite of the technical difficulties associated with the recovery of ODS solvents, action is still required to minimise their release to the atmosphere during use. In particular, the Regulation specifies:

- All precautionary measures practicable shall be taken to prevent and minimise leakages into the atmosphere of ODS solvents, including those used in feedstock and processing agents and in equipment containing ODS solvents
- This includes ODS solvent produced as an intermediary during the manufacture of other chemicals.

The European Chlorinated Solvent Association (ECSA) suggests that initially every step is taken to reduce

Table 7.4. Available solvent still types.

Type	Description
Simple distillation units	The most common method is simple distillation. During simple distillation, solvent wastes are heated, driving off the solvent in vapour form. The vapour is reverted back to liquid form in the condenser and collected. The ‘still bottoms’, or waste remaining in the bottom of the still is then collected and disposed of. Simple distillation units are run in batches.
Fractional distillation units	The second type of unit, fractional stills, produce a higher purity of recycled product. A fractional still may separate an industrial solvent blend into its pure constituents. Fractional distillation units are generally more expensive to operate and are generally better suited to larger volumes. Fractional distillation units are also usually batch units.
Thin film evaporators	The third type, thin film evaporators, distil by running a thin film of dirty solvent down a heated cylindrical vessel where it is vaporised. The vapours are collected and condensed back into liquid form for reuse. Thin film evaporators are generally suited for use in high-volume, continuous processes. Thin film evaporation requires the dirty solvent to have a low suspended solids content to work well.

emissions and consumption by enclosure of the equipment, making use of the inherent internal recyclability of chlorinated solvents, and increasing the efficiency of their use. These actions will minimise airflow and, as abatement technology is generally sized on airflow, will make any installation more economic. In extreme cases enclosure can reduce the consumption and emissions below the thresholds, and further abatement may not be necessary.

If abatement is needed, the three currently available technologies are:

- Adsorption on activated carbon
- Absorption in cartridge systems for ultimate disposal/off-site recovery
- Condensation of vapours at temperatures of –30°C to –180°C, followed by either recovery or destruction.

Adsorption is specifically adapted to single solvent processes or solvents non-miscible with water. The ECSA therefore recommends that installations using chlorinated solvents should be equipped with activated carbon recovery units so that the trapped solvent is reused eventually after re-stabilisation. This provides not only environmental but also economical benefit as the solvent consumption is drastically reduced. In the industrial cleaning sector, new-type totally enclosed degreasers combine both techniques (condensation and adsorption) to guarantee stack emission levels under 20 mg/m^3. It should be noted that activated carbon is the only technology allowing treatment of low fluxes, usually between 100 and 100,000 m^3/h, with solvent concentrations of up to 50 g/m^3.

Absorption in cartridge systems for ultimate disposal, or even off-site recovery, is currently of limited capacity, but likely to grow.

A non-exhaustive list of manufacturers of abatement equipment, with links if appropriate, is included in Appendix G.

The above information should be expanded and included in in-house training courses for technicians.

7.4.6 Disposal and destruction

Waste ODS solvents (and potentially used solvent containers) would be considered a hazardous material and are subject to the requirements of the relevant EU and Irish waste management legislation including:

- *Waste Management (Hazardous Waste) Regulations, 1998*
- *Waste Management (Movement of Hazardous Waste) Regulations, 1998*
- *Waste Management (Transfrontier Shipment of Waste) Regulations, 1998.*

Any ODS intended for disposal (including unused raw material) must be disposed with a licensed hazardous waste contractor. A list of licensed contractors is available on the EPA website (www.epa.ie). There are currently no suitable commercial destruction facilities in Ireland.

Alternative technologies acknowledged as being suitable for use in the destruction of ODS include:

- Liquid injection incineration
- Reactor cracking
- Gaseous/fume oxidation
- Rotary kiln incinerators
- Cement kilns.

The most likely disposal route will be high-temperature incineration. The party disposing of the waste must maintain the appropriate records of disposal for a minimum of 7 years.

A number of IPC-licensed facilities also operate incinerators for disposal of waste generated on-site. This may be a disposal route for waste ODS solvents if generated at these facilities. The operation of these facilities is subject to strict licensing and monitoring.

7.4.7 Alternatives to ODS solvents

As part of the VOC Directive the European Commission recommended that alternatives be selected on the basis of

- Fitness for use
- Potential effects on human health and occupational exposure
- Potential effects on the environment

- The economic consequences, in particular the costs and benefits of the options available.

There has been significant progress in the development of alternatives to ODS solvents. The alternative approaches can be placed into five categories as detailed below (Table 7.5). Further details on alternatives is presented in Table 7.6.

These alternatives are currently being promoted by EUROPA, *Ozone-Depleting Substance Uses and Alternatives,* and by the USEPA which has published a series of manuals aimed at particular industries. Each alternative must be adapted to suit the individual application and, in some cases, a combination of methods and chemicals may be required. A list of companies offering ODS alternatives for solvents is available on

http://europa.eu.int/comm/environment/ozone/alternatives.htm

The Solvent Alternatives Guide (SAGE) is a tool, published in co-operation with the USEPA, which can be used to assist in the selection of surface-cleaning alternatives. Designed to serve as an electronic handbook that identifies the most viable alternative for a given scenario, SAGE can be easily used and does not require a detailed knowledge of process chemistry or mechanics.

SAGE is available as a Windows-based programme, Winsage (1996), and as a downloadable PC version through the Control Technology Centre (CTC) in the US. Further information can be obtained on http://clean.rti.org.

The US Department of Navy (DoN) had thousands of applications for ODS solvent use; however, DoN has succeeded in reducing ODS use in this area by identifying and qualifying alternative solvents for specific applications. It developed and patented an ODS solvent replacement for use in oxygen systems piping and component cleaning operations. Use of this cleaner

Table 7.5. Alternatives to ODS solvents.

Alternative	Description
Avoid cleaning	This has become popular in the electronics market where specially formulated no-clean fluxes and solder pastes are being used. The burden of cleaning can also be reduced by switching to a water-soluble fluid or improving process technology; 100 kg of clothes dry-cleaned two decades ago would have consumed 10 kg of perchloroethylene: today's modern equipment performs the same job with little more than 1 kg
Volatile solvents	The most common chlorinated solvents that are not regulated as ozone depleters and that are suitable for cleaning metal and precision engineered parts are: • Trichloroethylene (trichloroethene) • Perchloroethylene (tetrachloroethene) • Methylene chloride (dichloromethane) These solvents however are subject to the requirements of the VOC Solvents Directive which sets emission limits and fugitive emission limits for volatile organic compounds from specified solvent-using industries. The directive is designed to yield a 67% reduction in VOC emissions and existing installations must fully comply with the Directive by 2007. The ECSA has reported that consumption trends in West Europe have been in steady decline. It reports that this has been due to the legislated phase out of 1,1,1-trichloroethane. ECSA members have all stopped producing 1,1,1-trichloroethane-based solvents since 1995, although some production for chemical intermediate use and permitted solvent uses continues HCF, HFE and PFC solvents are useful as solvents or as carriers for other solvents. Volatile flammable solvents are commonly used and work well on-ionic contaminants such as oils and greases. They include methyl alcohol (methanol), isopropyl alcohol (isopropanol), methyl ethyl ketone (MEK), ethyl acetate, butyl acetate. However, these are regulated under the Greenhouse Gas Directive
Low volatility solvents	There are many hydrocarbons and oxygenated hydrocarbon solvents that do not evaporate readily at room temperature, have lower flammability and have excellent solvency for oils and greases. The solvents included terpenes (from vegetation), petroleum distillation by-products or other synthetic chemicals. They are under continual development
Water	Oils, grease, rosin fluxes and other non-ionic contaminants can be cleaned with water once they have been solubilised or emulsified. When cleaning electronic assemblies the only contaminant of concern is flux. It is possible to formulate and use a flux that is removable by water alone. The main disadvantage is that they are formulated with stronger acidic activity
Non-solvent processes	There is an expanding range of other processes for cleaning surfaces, such as blasting the surface with air or microscopic particles of dry ice, plasma cleaning, steam cleaning, supercritical fluids or decamping and volatilising the contamination using ultra-violet light or a vacuum–thermal process. These are generally not applicable to all soils and surfaces

Table 7.6. Summary of a range of alternative chemicals and processes commonly recommended as replacement for ODS use.

		Metal and precision cleaning	Electronic defluxing	Dry-cleaning	Adhesive formulation
Avoid cleaning	Just stop cleaning	✓	✓	X	X
	Change process	X[a]	✓[b]	X	✓
Volatile solvents	Chlorinated solvents	✓	X	✓	✓
	HFC, HFE, and PFC solvents	✓	✓	X	✓
	Alcohols, ketones and esters	✓	✓	X	✓
Low volatility solvents	Hydrocarbon solvent forced evaporation	✓	✓	✓	✓
	Hydrocarbon solvent water, then rinse dry	✓	✓	N/A[c]	N/A
	Hydrocarbon/water emulsion, water, rinse dry	✓	✓[d]	N/A	N/A
Water	Water plus detergent	✓	✓	X	✓
	Change process	X	✓	N/A	✓
Non-solvent process	Dry-ice blasting	✓	X[e]	X	X
	Supercritical carbon dioxide	✓	✓	X	X
	Plasma	✓	X[e]	X	X
	Thermal vacuum	✓	X	X	X
	UV/ozone	✓	X[e]	X	X
	Steam cleaning	✓	X	X	X

Notes:
✓, an alternative can be considered for the application.
X, the alternative is not suitable for the application.
[a]There may be opportunities to change a process route and eliminate a cleaning step; the specification requires that the contamination will be removed by cleaning.
[b]'No clean' fluxes.
[c]NA means not applicable.
[d]Water-soluble flux.
[e]These procedures are capable of removing flux and handling contamination from bare circuits boards but may be restricted in cleaning under components.

option is expected to reduce its use of ODS solvents by more than 450 tonnes annually. Many contractors are also working with DoN to eliminate ODS usage in their operations, thus reducing cost and increasing productivity.

Virtually all solvents are regulated under the Solvent Emission Directive (translated into Irish legislation as the *Emission of Volatile Organic Compounds from Organic Solvents Regulation 2002*, SI No. 543). Solvents are generally hazardous to health and are regulated in the UK under COSHH. The hazardous nature of solvents is a critical factor to consider when selecting a treatment method. The Health and Safety Executive has published a fact sheet regarding the Health and Safety at degreasing operations: sources of guidance, which lists all the available guidance notes and their location.

All ODS solvent users are strongly recommended to contact their suppliers and/or industry associations to discuss their specific circumstances. In addition, a large body of research is available regarding the application of ODS solvent alternatives, both within the EU and elsewhere.

7.4.8 Implementation and incentives

The EU Commission (2000) provided an outline of potential incentives to encourage halon phase out in line with the requirements of Regulation 2037/2000; these can also be applied to solvent use. It also outlined methods of publicising the requirements for such phase out. Guidance on raising public awareness on the need for ODS solvent phase out is also available from UNEP at:
http://www.uneptie.org/ozonaction/library/awareness/main.html

The European Commission recommends three types of incentives, namely:

1. Economic incentives

Direct economic incentives include subsidising the use of ODS solvent alternatives, providing that any decommissioned solvents are appropriately disposed of. Other incentives include subsidising ODS solvent disposal costs.

Indirect economic incentives apply an indirect value to ODS solvent through the use of duty exemptions, grants and reduced rate loans for the installation of alternatives.

2. Legislation

Enforcement procedures can be developed to encourage the phase out of ODS solvents, with penalties for ongoing use and also for illegal venting or disposal. The EU Commission specifies that penalties should be effective, proportionate and dissuasive in order to discourage breaches of the Regulation.

3. Voluntary approach

As the deadline for decommissioning of non-critical ODS solvent use has passed, the opportunity for use of a voluntary approach is not a suitable option in Ireland. Disposal of ODS solvents and substitution of ODS solvents in any processes should be completed as soon as practicable. Whilst many facilities in Ireland have voluntarily phased out ODS solvents without prompting from the Competent Authority, any of those remaining should be required to have replacement systems installed.

7.4.8.1 Awareness raising

This will be a vital aspect in phase out of any the remaining ODS solvent users in Ireland. Suppliers and users should receive specific and relevant information on the requirements for ODS solvent phase out, including such information as:

- Data on alternatives (advantages, disadvantages, environmental impact)
- Details of manufacturers and suppliers of suitable equipment.

7.4.8.2 Publicity on ODS solvent phase out

Awareness on the requirements for ODS solvent phase out could be targeted at a number of specific sectors including:

- Third-level institutions
- Independent and state-sponsored laboratories
- The aerospace industry
- Precision cleaning industry.

Depending on the sector, the best approach may be direct contact or through trade magazines, through trade associations or through suppliers.

Examples of publicity materials and methods include:

- A one- or two-page brochure that provides an overview of the salient points of the Regulation
- A detailed guidance document which provides detailed information on the regulatory requirements
- A website with links to other sources of information including information on the regulations, decommissioning options, alternatives suppliers
- Articles in trade publications, or
- Conferences and workshops targeting various industry sectors or, alternatively, presentations at trade conferences.

7.5 Summary Gap Analysis and Recommendations

Table 7.7 provides a summary of the current systems in place to control the use and phase out of ODS solvents in Ireland. Suggested recommendations are also made, based on international best practice measures identified during the study.

In addition to detailing gaps related to Articles 16 and 17 of the Regulation, Table 7.8 provides an overview of other gaps that have been identified during the course of this study. Recommendations are also included on how these gaps may be addressed based on a review of best practice measures.

Table 7.7. Summary of gap analysis for Articles 16(5), 16(6), 17(1) and 17(2) for ODS solvents.

Article	Situation at the time of reporting	Recommendations
Article 16(5)		
a) Promotion of the recovery, recycling, reclamation and destruction of controlled substances **b)** Assign responsibilities for ensuring compliance **c)** Define minimum qualification requirements **d)** Report to the Commission on programmes related to qualification requirements by 31 December 2001	**a)** There are no specific formal programmes in place to promote the recovery, recycling, reclamation or destruction of ODS solvents in particular. However, many large solvent users in Ireland are licensed under the IPC (Integrated Pollution Control) licensing system. These operators are required to employ Best Available Technology (BAT) to minimise solvent usage and release to atmosphere. Disposal of waste solvents from these sites is also regulated and must be carried out in compliance with national and EU waste legislation. Volatile Organic Compounds (VOC) usage in smaller facilities (not holding an IPC licence) may be covered by the requirements of Statutory Instrument No. 153 of 2002 *Emissions of Volatile Organic Compounds from Organic Solvents Regulations* (the Solvents Directive) which is currently being implemented in Ireland. This also specifies requirements in relation to solvent usage and emissions minimisation in a number of industry sectors. As part of the implementation of the Directive, best practice guidelines have been published for the vehicle-refinishing sector and the dry-cleaning sector, with guidance for other sectors to follow **b)** Formal responsibility for compliance with the Regulation has not been assigned **c)** Minimum qualifications have not been defined and there are no formal (certified) training programmes available in Ireland. However, a best practice guidance document for solvent use has been published by Enterprise Ireland (www.envirocentre.ie) which includes guidance on delivery, storage and distribution of solvents. The HSA also has guidance in relation to safe use of chemicals in general (www.hsa.ie) **d)** No report has been submitted; however, this gap analysis forms part of the reporting requirements to the Commission	**General recommendation** In order to effectively implement the legislation, the first measure required would be the designation of a Competent Authority (CA) by the DEHLG. It is recommended that the EPA is the most appropriate CA for this Regulation. It is also recommended that the EPA and LAs are the most appropriate enforcement bodies for ODS solvents (see Section 8). The CA should focus in the first instance on addressing areas of non-compliance as identified in this report, on the detailed recommendations herein, and prioritise reporting to the Commission using the agreed reporting format It is recommended that the CA should implement the following actions: **a)** • Publish a Guidance Note to assist producers, users, importers, exporters and those involved in the reuse, recovery and disposal of solvents, particularly including those involved in maintenance and servicing of equipment containing ODS solvents • Implement a focused awareness-raising campaign **b)** The assigned CA (the EPA, as suggested above) is formally responsible for ensuring compliance (in Ireland) with the requirements of the Regulation. The CA itself can designate responsibility to other bodies, as discussed in Section 8, which proposes an implementation strategy. Establish a communication and reporting framework so that information is submitted to the LA for forwarding to the CA and DEHLG as necessary to ensure recovery of ODS solvents for destruction, recycling or reclamation (i.e. to ensure compliance with Article 16(1)) **c)** Assign responsibility to the CA to define minimum qualification requirements. The UNEP website provides a large volume of training manuals and promotional material aimed at the phase out of ODS which could be adapted to suit the situation in Ireland, and incorporated into a training course (see References in Section 7.6) or existing training material in relation to safe use of solvents/chemicals. http://www.unepie.org/ozonaction/library/training/main.html **d)** Report to the Commission on defined minimum qualification requirements

Table 7.7. *contd*

Article	Situation at the time of reporting	Recommendations
Article 16 (6)		
a) Report to the Commission on systems established to promote the recovery of used controlled substances by 31 December 2001 and annually thereafter **b)** Report to the Commission on the quantities of used controlled substances recovered, recycled, reclaimed or destroyed by 31 December 2001 and annually thereafter **c)** Report to the Commission on the facilities available for recovery, recycling, reclamation or destruction of used controlled substances by 31 December 2001 and annually thereafter	**a)** No reporting to the Commission has been carried out specifically in relation to ODS solvents. Promotion of solvent minimisation has been carried out in Ireland through the IPC licensing system, and also through the implementation of the Solvents Directive (1999/13/EC) **b)** No reporting to the Commission is carried out on the quantities of used controlled substances recovered, recycled, reclaimed or destroyed **c)** There are no commercial facilities licensed for the destruction of ODS solvents in Ireland. Several pharmaceutical sites in Ireland operate hazardous waste incinerators licensed under the IPC system and may carry out destruction of ODS solvents on site. Other solvent materials are sent to commercial incinerators in Europe under TFS documentation; hence, while records of total solvent disposal would be available, there would be no specific figures on ODS solvents. There is a proposal to construct at least one commercial hazardous waste incinerator in Ireland based on the National Hazardous Waste Management Plan	**a)** • Publish a Guidance Note for the industrial and commercial sector, including a list of available disposal contractors, alternatives to ODS solvents and details of options for replacement of ODS-containing equipment • Ensure dissemination of guidance (web, trade fairs, workshops, etc.) for the industrial and commercial sectors **b)** The information required in terms of reporting obligations under Regulation 2037/2000 is already available through TFS documentation. Therefore, it is suggested that in addition to the current reports submitted to the EPA by the LAs, the LAs are also requested to separately note any specific shipments of ODS, and report these separately to the CA **c)** Report to the Commission on current information available and future actions planned
Articles 17(1) and 17(3)		
a) All precautionary measures practicable should be taken to prevent and minimise leaks of controlled substances used as feedstock and processing agents **b)** Equipment with a refrigerating fluid charge of more than 3 kg shall be checked for leaks annually **c)** Define the minimum qualifications for personnel involved in leak detection and report to the Commission by 31 December 2001 on the programmes related to the qualification requirements	**a)** ODS solvents should now only be used as a feedstock or processing agent; hence, leakage is likely to be related mainly to storage prior to use. Guidance on delivery, storage and distribution of solvents is included in the Enterprise Ireland Guidance Note on solvents **b)** Not applicable to ODS solvents **c)** No qualification requirements have been defined in Ireland for those involved in leak detection with regard to ODS solvent-containing systems. Under the IPC licensing system all staff with responsibilities which could potentially result in environmental impact are required to undergo suitable training; hence, any such equipment in IPC-licensed facilities should be maintained by suitably qualified personnel. Equipment containing ODS solvents can no longer be imported (unless they were manufactured prior to entry into force of the Regulation); hence, the quantity of such equipment in use is expected to be small	**a)** The Guidance Note to be published by the CA will refer to Enterprise Ireland's best practice guidance document on solvents (www.envirocentre.ie) which includes best practice guidelines for delivery, storage and distribution of solvents. The manufacturer's instructions regarding the handling and use of ODS solvents typically specify measures for the prevention of leaks during use. Compliance with these instructions is considered important in meeting the requirements of the Regulation. This could also be incorporated into a user training course **b)** Assign responsibility to the CA to define minimum qualification requirements. Solvent loss prevention best practice guidance is outlined in Enterprise Ireland's best practice guidance document on solvents (www.envirocentre.ie), including information on recovery and reuse, avoiding spills and maintenance to prevent leaks. This could be used as the basis of in-house training for companies who continue to use equipment containing ODS solvents. Report to the Commission on defined minimum qualification requirements
Article 17(2)	Not applicable to ODS solvents	

Table 7.8. Summary of gap analysis for ODS solvent use and phase out (general summary only, not exhaustive interpretation of the Regulation).

Topic	Situation at the time of reporting	Recommendations
Import and export		
Articles 6–12	Any company in Ireland wishing to import or export ODS solvents (into or out of the EU) must apply for authorisation from the Commission as per EC 2037/2000. The Licence must be renewed each year and data on the amount of ODS solvent imported/exported must be reported annually to the Commission. The reporting role is currently performed by the Department of the Environment Heritage and Local Government and no authorisations are in place From CSO figures, it appears that chemical imports have taken place but these may have been misidentified and mislabelled	**General recommendations** • It is recommended that the current systems controlling the import and export of ODS solvents in Ireland be strengthened, to increase the level of awareness of the control dates within the Regulation. It is suggested that promotional information be developed aimed at potential ODS solvent importers, suppliers and users that specifies the requirements of the Regulation in plain language. This information should be incorporated into the guidance document for operators in this sector • It is recommended that the Customs and Excise service be designated as the enforcing authority in relation to the import and export of controlled substances. Customs officers should familiarise themselves with the obligations of the Regulation and participate in occasional Commission-sponsored training as it arises. Furthermore, custom authorities should also be familiar with the UNEP website which provides access to a Training Manual and promotional video specifically aimed at customs officers http://www.unepie.org/ozonaction/library/training/main.html
Supply and use		
Article 4	The use of ODS solvents is not regulated under Irish law (other than peripherally through the *Chemical Agents Regulations, 2001* and other associated dangerous substances legislation, and through legislation transposing the VOC Solvents Directive), and there are currently no reporting requirements. There is currently no centralised register of Licensed outlets or record of ODS solvent sales The use of ODS solvents in laboratories and third-level institutions is not regulated and does not appear to be tracked. The current study was not able to determine how much ODS solvents are being used and by whom	The assigned Competent Authority (the EPA, as proposed above) is formally responsible for ensuring compliance (in Ireland) with the requirements of the Regulation. The CA itself can designate responsibility to other bodies, as discussed in Section 8, which proposes an implementation strategy. Establish a communication and reporting framework so that information on quantities of ODS solvents authorised for critical, essential, feedstock, processing agents and laboratory uses can be collected by the CA for reporting

7.6 References and Useful Information

7.6.1 References

DETR/DTI, 2001. *Phase Out of Ozone Depleting Solvents. Advice on Alternatives and Guidelines for Users of CFC, HCFC and 1,1,1-Trichloroethane.* Department of Trade and Industry, London.

Department for the Environment and Rural Affairs – *Advice on Alternatives and Guidelines for Users of CFC, HCFC and 1,1,1 Trichloroethane*.

EU-Council Directive 1999/13/EC on the Limitations of Emissions of volatile organic compounds due to the use of organic solvents in certain activities and installations, 1999.

Health and Safety Executive (HSE) UK, *Health and Safety at Degreasing Operations*, sources of guidance, www.hse.gov.uk

UNEP, 2001. *Protecting the Ozone Layer Vol. 2, Solvents, Coatings and Adhesives*.

Regulation (EC) No. 304/2003 of the European Parliament and of the Council of 28 January 2003 concerning the Export and Import of Dangerous Chemicals.

Enterprise Ireland, Best Practice Guide No. BPGCS001, *Good Housekeeping Measures for Solvents*. http://www.envirocentre.ie/guides.asp?id=24#2

USEPA, 1992. EPA Fact Sheet: *Considerations in Selecting a Commercial (off-site) Solvent Recycling Service*.

USEPA, 2001. *EPA Pollution Prevention – Legal Considerations for On-Site Solvent Recycling.*

7.6.2 Other useful information

- *Statutory Instruments S. I. No. 220 of 2003 European Communities (Dangerous Substances and Preparations) (Marketing and Use) Regulations 2003.*

- *Poisons Regulation, 1961*
  http://www.irishstatutebook.ie/ZZA12Y1961.html

- Clean Technology Centre Cork, *Quantification and Tracking of (Industrial) Solvents and other Products to Estimate VOC Emissions to Air.* The underlying objective of this project is to devise and apply to Ireland an emissions inventory methodology for NMVOCs in selected sectors. International practice is examined to provide a 'state-of-the-art' review. Co-financed by: Environmental Protection Agency.
  http://www.ctc-cork.ie/projects/framproj.htm

- Clean Technology Centre Cork: *The Use of Cleaner Production Technologies in the Electronic and Metal Finishing Industries*. The objectives of this project were to identify and assess relevant cleaner production technologies in the metal-finishing and electronics industries, and to recommend technologies with particular potential for further development in Ireland. The results of the project were published in three reports by the EPA.

7.6.3 Links

- UNEP Ozone Action Programme
  http://www.unepie.org/ozonaction/

- UNEP Ozone Secretariat
  www.uneo.org/ozone

- European Chemicals Bureau Imports and Exports
  http://ecb.jrc.it/import-export/

- European Chemicals Bureau
  http://ecb.jrc.it/new-chemicals/

- Health and Safety Authority: Import/Export of Dangerous Chemicals
  http://www.hsa.ie/safety/chemical_awareness/hsau/import_export.htm

- Becca, supplier of solvent recovery systems
  http://www.beccainc.com/solvent.htm

- Europa Ozone-Depleting Uses and Alternatives
  http://europa.eu.int/comm/environment/ozone/alternatives.htm

- European Chlorinated Solvents Association (ESCA)
  http://www.eurochlor.org/tools/publications/publications.htm

- European Commission's Responses to FAQs
  ww.europa.eu.int/comm/environment/ozone/faqs.htm

8 Suggested Implementation Strategy

8.1 Background

Implementation of the Regulation can be addressed under three main headings:

1. Administrative arrangements
2. Regulation
3. Reporting.

8.2 Administrative Arrangements

A number of Competent Authorities (CA) are required to be designated by each Member State under the Regulation and there is also a need for an overall lead responsibility to be designated for implementation of the Regulation. It is recommended that the Environmental Protection Agency is the most appropriate lead body to implement and oversee enforcement of the Regulation in Ireland. It should be noted that inspection measures are also likely to be required to ensure compliance with the requirements of the Regulation. The structure proposed is outlined in Fig. 8.1. The additional Competent Authorities recommended to ensure enforcement of the Regulation include:

- Local Authorities
- Pesticide Control Service and Forest Service of the Department of Agriculture and Food
- Customs and Excise of the Revenue Commissioners
- Maritime Safety Directorate of the Department of Communications, Marine, and Natural Resources.

As the CA, the EPA will provide all Member State reporting requirements under the Regulation to the DEHLG. The DEHLG will review and forward to the Commission as appropriate. The EPA is considered the most appropriate CA for the following reasons:

- It compiles the National Waste Database and receives summary TFS (Transfrontier Shipment) data for wastes leaving the State (the required detail is specified by the EPA to the Local Authorities). All recovered controlled substances should be exported from the State as waste for destruction and documented as such, in the absence of suitable disposal facilities
- It issues and enforces all IPC and Waste Licenses and is therefore well positioned to add enforcement of the Regulation to its activities. Conditions could be added to IPC and Waste Licenses regarding compliance with the Regulation
- It has a supervisory role in relation to the function of Local Authorities in relation to environmental protection and is therefore in a position to assess Local Authority enforcement of non-IPC activities under the Regulation
- It has national coverage through Regional Inspectorates
- It is best positioned to issue the Guidance Notes for the various sectors and deal with any subsequent queries.

In the case of non-IPC/Waste-licensed activities, it is proposed that responsibility for administration and enforcement of the EU Regulation should be assigned to Local Authorities. In this regard, it is envisaged that each Local Authority would identify all relevant undertakings in its functional area, establish and maintain an appropriate register of such undertakings, and put in place appropriate compliance monitoring (inspection) and reporting arrangements. Undertakings covered by the EU Regulation (and not licensable by EPA) should be required to register with their Local Authority by a specified deadline.

The register of undertakings to be established and maintained by each Local Authority in respect of its functional area, should be developed in consultation with the EPA. Establishment of a register should include arrangements for it to be reviewed and updated annually by the Local Authority. Once established, a copy of each register should be provided by the Local Authority to the Agency. Where an annual review results in an updating of a register, a copy of the updated register should be provided to the Agency.

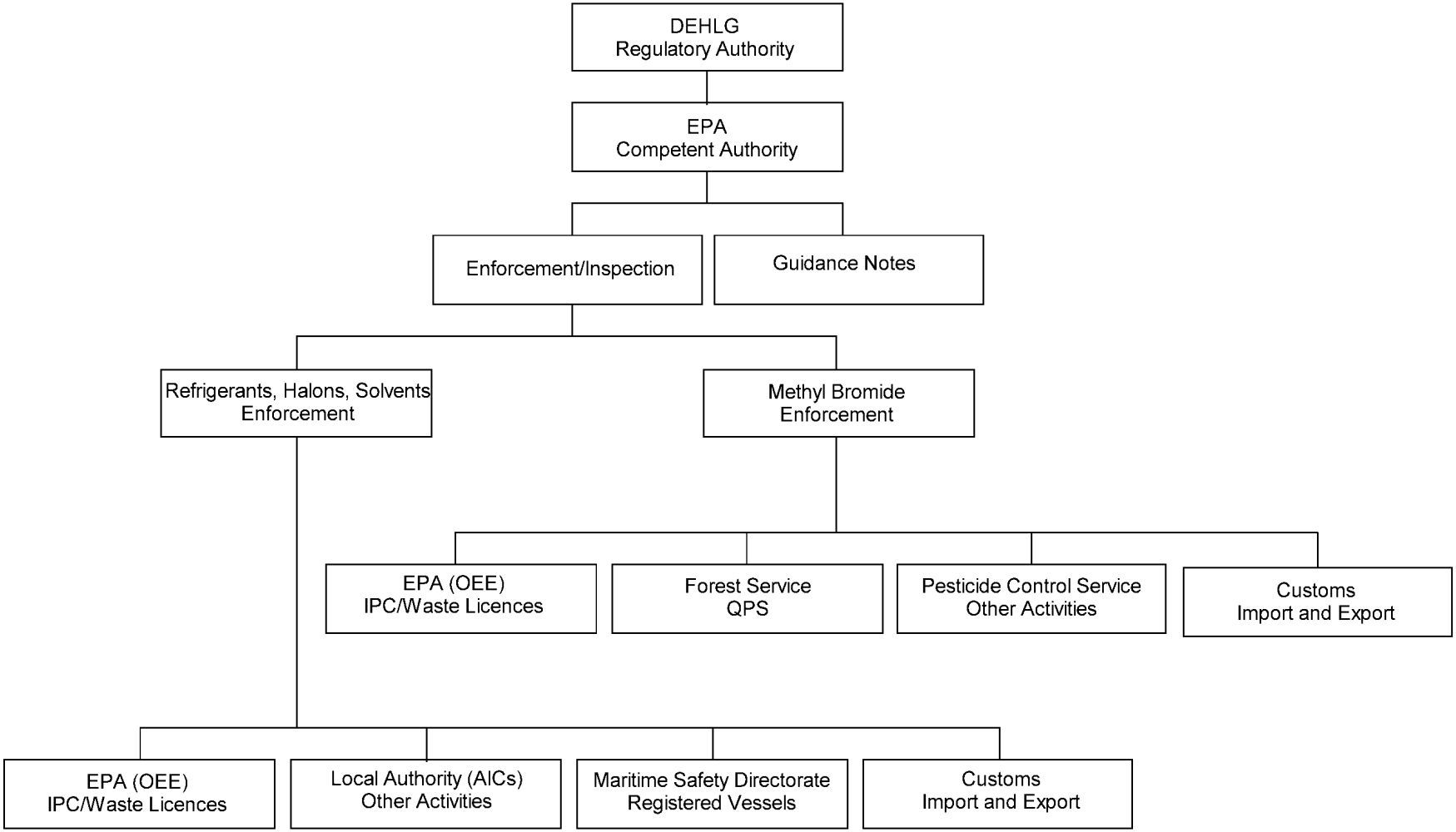

Figure 8.1. Proposed enforcement/inspection structure for implementation of Regulation 2037/2000.

Local Authorities may opt to use AICs (Accredited Inspection Contractors) to carry out inspections of individual undertakings and report on compliance with the Regulation, similar to the arrangement currently being put in place in relation to emissions of volatile organic compounds (VOCs) from organic solvents. A copy of each inspection report should be provided by the Local Authority to the EPA.

With regard to methyl bromide it is recommended that the most appropriate enforcement body is the Pesticide Control Service (PCS) of the Department of Agriculture and Food for non-IPC/Waste-licensed activities and activities not related to timber and/or timber products. For quarantine and preshipment applications relating to timber and timber products the Forest Service is recommended as the most suitable Competent Authority.

The Maritime Safety Directorate of the Department of Communications, Marine and Natural Resources incorporates key relevant offices such as the Marine Survey Office (MSO), which is responsible for the implementation of all national and international legislation in relation to safety of shipping and prevention of pollution of the marine environment from ship-based sources. The MSO has already taken a proactive role in this area by issuing a Marine Notice on halons (see Section 5.3.2).

With regard to enforcement of the requirements of the Regulation in relation to the import and export of controlled substances, it is recommended that the Customs and Excise service be designated as the enforcing authority.

8.3 Regulation

As EU Regulations apply directly to Member States, transposition into national legislation is not required. However, in order to designate Competent Authorities and make related provisions, it is suggested that national Regulations be enacted. The Regulation(s) should, in particular, require:

- Application to the Commission for authorisation to produce or import essential use controlled substances (Article 3)
- Provision for steps to ensure that controlled substances are recovered and processed appropriately (Article 17)
- That precautionary measures are taken to prevent leakages of controlled substances (Article 17)
- That responsibility for recovery of controlled substances is assigned (Article 16(5))
- That minimum qualification requirements are defined with respect to recovery activities, leakage checks, etc. (Articles 16(5), 17(1) and 17(2)).

8.4 Reporting

There are a number of direct reporting responsibilities referred to in the Regulation and these are summarised in Table 8.1 below. Additional reporting routes recommended as part of the implementation arrangements are detailed in Fig. 8.2.

Reporting requirements for all relevant bodies should be highlighted in the guidance notes issued by the Competent Authority for each of the groups of controlled substances as discussed in this report.

8.5 Cost Implications

The following institutional strengthening and training cost items have been identified:

- Additional technical and administrative staff at the EPA (estimated minimum requirement is one technical officer and one administrative officer; additional requirements would be subject to further assessment of needs by the EPA)
- Training (e.g. requirements of the Regulation, guidance documents)
  - EPA personnel
  - Local Authority officials
  - PCS officials
  - Customs officials
- Printing and distribution of Guidance and Awareness documents.

Table 8.1. Reporting requirements referred to directly in the Regulation.

Article	Relevant bodies	Information outline
3	Competent Authority to notify the Commission	Reporting in relation to production authorisations
4(1)	Competent Authority requests to the Commission	Request for exemption to use of CFC in specific applications until 31 December 2004 and 31 December 2008
4(2)(i)	Competent Authority request to the Commission	Request for increased quantities of methyl bromide
4(2)(iii)	Member State to report to Commission	MB quantity authorised for QPS use
4(4)(iv)	Competent Authority to report to Commission	Halon quantities used in critical uses, emission-reduction measures, emission estimate, identification of alternatives
5(3)	Member State to report to Commission	Inform Commission if HCFC is to be used to replace halons in fire-fighting systems
5(7)	Competent Authority request to the Commission	Request for exemption for use and placing on market of HCFCs
6(1)	Commission to report to Competent Authority	Copies of import licences to be sent to Competent Authority
6(2)	Competent Authority to notify Commission	Approval of ODS used for inward processing relief
12(1)	Commission to report to Competent Authority	Copies of export licences to be sent to Competent Authority
12(4) from Reg. 1804 of 2003	Competent Authority to notify Commission	Verification of compliance with Article 11(1)(d) that halons exported for critical uses are stored in facilities operated or authorised by the Competent Authority
16(5)	Member State to report to Commission	Qualification requirements related to recovery of ODS
16(6)	Member State to report to Commission	Systems established to promote recovery of ODS
17(1)	Member State to report to Commission	Qualification requirements with regard to leak detection
19(1)	Producer, Importer, Exporter to report to Commission (and copy to Competent Authority)	Production, import and export data
19(2)	Customs Authorities to report to Commission	Send stamped used licence documents to Commission
19(3)	Essential users to report to Commission (and copy to Competent Authority)	Nature of use, quantities used, held in stock, recycled or destroyed, and quantity of products containing controlled substances place on the EU market or exported
19(4)	Those authorised to use controlled substances as processing agents report to Commission	Quantities used and estimate of emissions
20(2)	Commission to report to Competent Authority	Copy of request for information from Commission to any undertaking to be sent to Competent Authority
20(3)	Member State to report to Commission	Schedules and results of random checks on imports of controlled substances
21	Member State to report to Commission	Report to Commission on penalties put in place in relation to breach of the Regulation

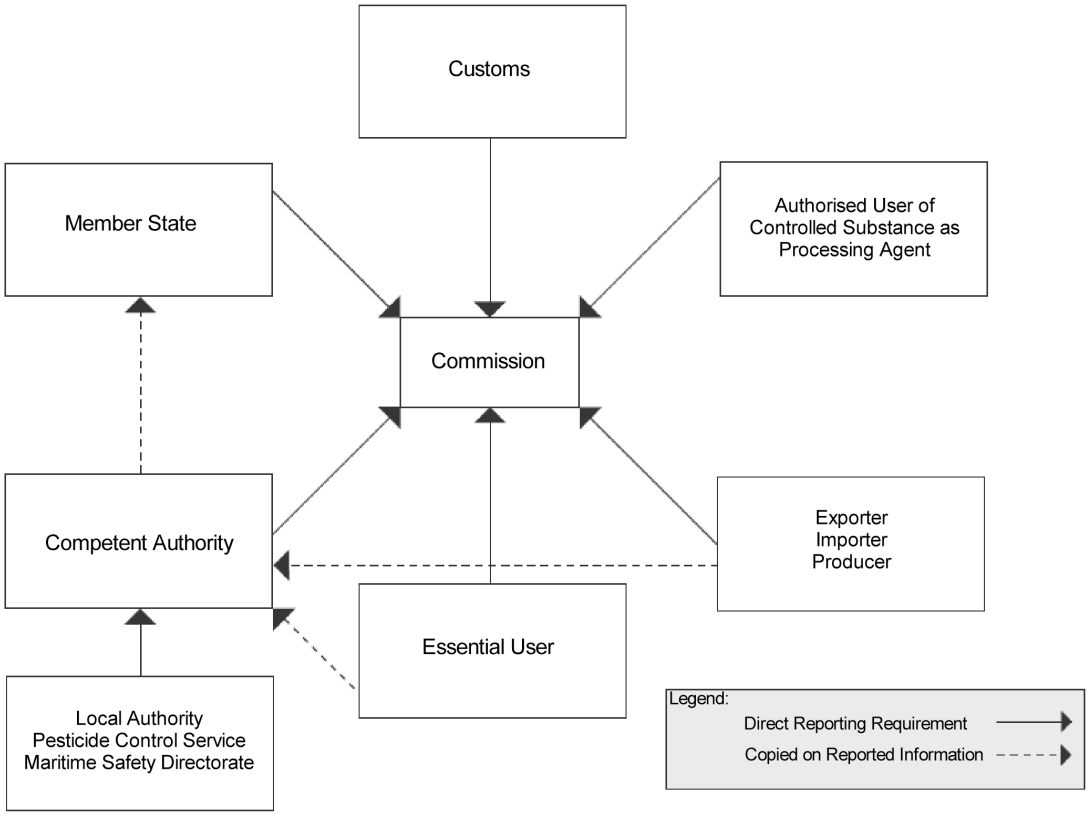

Figure 8.2. Proposed reporting structure for Regulation 2037/2000.

Appendix A CFC and HCFC Refrigerants Contact List

Company	Name	Phone	Comments
IVAX	Vincent Kennedy	+353-(0)51-331331	Exemption to use CFC-11 and CFC-12
Murco Ltd.	Lorcan Maher	+353-(0)1-2846388	Sale of refrigerant leak detectors
M Baker	JA@mbakergroup.co.uk	+44-1392433912	Domestic refrigerator disposal
Linde	Jim Whelan	+353-(0)1-45125585	Supplies refrigeration units
Kilkenny Cooling Systems		+353-(0)56-7722913	Manufactures cool rooms
Nationwide Dairy Refrigeration	Hugh O'Neill	+353-(0)1-4579074	Maintains dairy cooling systems
Anglo-Irish Refrigeration	John Carey	+353-(0)1-8350866	Supplies shops and retail units with refrigerators
Auto Air	Brendan Kealy	+353-(0)86-2023523	Air conditioning in cars
Irish Rail	Michael Nugent	Micheal.Nugent@ irishrail.ie	Rail transportation
Reefer Tech	Mick Homes	+353-(0)1-8366794	Refrigerated shipping containers
Tesco	Jim Dwyer	+353-(0)1-2808441	Retail refrigeration users
Superquinn	Kieran Coffey	+353-(0)1-2831660	Retail refrigeration users
Cross Refrigeration	Chris McFaddan	+353-(0)1-4511915	Supply and maintenance of refrigeration equipment
Dunnes Stores	Micheal Dooley	+353-(0)1-6112100	Retail refrigeration users
Irish Bacon Suppliers	Majella O'Callaghan	+353-(0)21-3769	Meat processors
Whelan Stores	Paul O'Brien	+353-(0)21-4811823	Refrigeration ships
Cold Chain		+353-(0)45-874788	Transport refrigeration
Danfoss Ireland	John Sampson	+353-(0)1-628111	Refrigerator suppliers
RSL	Seamus Kerr	+353-(0)1-4508001	Dispose of CFCs
Tech Refrigeration	Vincent Weldon	+353-(0)1-8208544	Refrigerator suppliers
Skillsnet	Enda Hogan	+353-(0)1-8783773	Training

Appendix B Halons Contact List

Company	Name	Phone	Comments
Bord Gais	Liam Hearn	+353-(0)21-4534000	
UK DEFRA	Stephanie Godliman	+44-2070828166	
Bord Iascaigh Mhara	Ray Murray	+353-(0)1-2144100	Advise fishermen on safety issues
National Safety Centre	James McConnell	1850-234600	
Marine Surveyors Office	Ian Wallace	+353-(0)1-8744900	Inspect ships
Motorsports Ireland		+353-(0)1-6775628	Still use halon
Electricity Supply Board	Donagh O'Mahoney	+353-(0)1-7027277	
Electricity Supply Board	Gerry Lawlor	+353-(0)1-7027118	
Walker Fire	Brendan Morgan	1800-200-901	
Apex Fire Systems	Pat Farrell	+353-(0)1-4533177	
AJ Edge	Bernard Roche	+353-(0)1-2864700	Historically recycled large quantities of halon
Chubb Ireland	Brian Booth	+353-(0)1-2953333	
FLS Aerospace	Brian Keogh	+353-(0)1-8862992	Still use halon
Aer Lingus	Mark Dunphy	+353-(0)1-8862089	
Siemens Fire Protection	Ian Bonar	+353-(0)1-4508920	
Lufthansa Airmotive	Environmental Mgr.	+353-(0)1-4011111	
Shannon Aerospace	Clare Lynch	+353-(0)61-370000	
Dublin Fire Brigade	Mark Doyle	+353-(0)1-6734067	
Irish Navy	Sean Cremin	+353-(0)21-4864960	All halon removed
Irish Army	Mattie Briody	+353-(0)1-8046204	No halon in use
Irish Air Corps	Colin Roche	+353-(0)1-4037631	Halons still in use and stored on site
Murco Ltd.	Lorcan Maher	+353-(0)1-2846388	Sale of halon leak detectors
Halon National Users Consortium (UK)	Brian Dale	+44-1420538855	No response
Department of the Environment Heritage and Local Government	Sean Hogan	+353-(0)1-8882374	
Conoco/Philips Whitegate Refinery	Ger Downing	+353-(0)21-4622200	

Appendix C Methyl Bromide Contact List

General contacts for use and phase out of methyl bromide.

Name	Contact no.	Contact name	Comments
Department of Agriculture – Pest Control Service	+353-(0)1-6072655	Dan Murphy	Data on imports
Department of Agriculture – Pest Control Service	+353-(0)1-6072613	Dr Mark Lynch	Management of MB
Department of Agriculture – Pest Control Service	+353-(0)1-6072655	Tom O'Flaherty	Management of MB
Department of Agriculture and Food – Forest Service	www.agriculture.gov.ie		Register MB use under ISPM15
Department of Agriculture – Food and Forestry	+353-(0)1-6789011	Tom McDonald	ISPM15
National Standards Authority	+353-(0)1-8073800	Bob Davies	ISPM15
Central Statistics Office	+353-(0)67-33533	Martin Storey	Data on imports
British and Irish Pest Control Associations	+353-(0)1-6704965	Tom O'Toole	List of members
Teagasc – Advisory and Training Service	+353-(0)59-9170218	Paddy Browne Dave McGrath	No training
ICA – College of Horticulture			Closed
Eastern Regional Health Board	+353-(0)1-4609644	Mary Keane	Poisons Register
Health and Safety Authority	+353-(0)1-6147052	Majella Cummins	MB covered under *Poisons Act* and Chemical Agents Regulations
Health and Safety Authority – Occupational Hygiene	+353-(0)1-6147060	Rosheen McKenny	
Health and Safety Authority – Marketing and Use Regulation	+353-(0)21-4251212	Kevin Buckley	MB not covered under Marketing and Use Regulation.

List of chemical manufacturers and suppliers of methyl bromide (sourced from the Golden Pages).

Name	Contact no.	Contact name	Produce or supply MB
Abbey Chemicals	+353-(0)46-9022975		No
Absolutions Food Safety	+353-(0)87-2029040		No
Action Clean	+353-(0)87-2577639		No
ADM Ringaskiddy	+353-(0)21-4378901	John White	No
Advance Chemicals	+353-(0)1-8301933		No
Agricultural Chemical	+353-(0)61-385226		No
Agru Irl Ltd	+353-(0)51-379474		No
Air Products Ireland Ltd.	+353-(0)1-8455111		No
Aire Laboratories Ltd	+353-(0)25-39024		No
Albion Chemical Distribution (IRL) Ltd	+353-(0)1-4600360		No
Alman Chemical Co.	+353-(0)90-9741028		No
Anachem	+353-(0)21-4373175		No
Antech Ltd	+353-(0)51-392391		No
Applied Chemex	1890-924524		No
Applied Chemicals Ireland Ltd	+353-(0)1-4600977		No response
Arch Chemicals BV	+353-(0)1-8908000		No
Arco Industrial Supply	+353-(0)1-8880900		No
Arran Chemical Co. Ltd	+353-(0)90-6595807	Fiona/Peter	No
Arrest-A-Pest	+353-(0)52-21563	Nollagh/Pat	No
Ashland Chemicals & Hygiene Supplies Ltd	+353-(0)48-77767007	Mr Ashfield	No
Aughinish Alumina Ltd	+353-(0)61-604000	Bernard Loughlin	No
BASF Ireland Limited	+44-161-4885176	Peter Layton	No
Bayer Crop Science	+353-(0)1-8132255		No
Bayer Ltd	+353-(0)1-8132222		No
Best Chemicals Ltd	+353-(0)51-396888		No
Biachem Europe (Distribution) Ltd	+353-(0)59-9136930		No
Biocel	+353-(0)21-4353516	Donal O'Dubghain	No
Bray Chemicals	Number invalid		-
Breen Chemicals Ltd	+353-(0)54-66500		No
C & G Logistic Group	+353-(0)1-8208455		No
Camida	+353-(0)52-25455	Yvonne Mullins	No
Cedele	+44-78-70558636 +44-1782-596867	Cathy McFall Maurene Bennett	Yes – supply to Ireland
Central Chemical Supplies Ireland Ltd	+353-(0)1-8332281		No response
Chembrite (Ireland) Ltd	+353-(0)71-9641967		No
Chemco (Ireland) Ltd	+353-(0)1-4569761		No
Chemcraft Industries Ltd	+353-(0)1-4976888		No
Chemical Analysis Laboratory	+353-(0)1-2360755		No
Chemical Direct Ltd	+353-(0)1-8118920		No
Chemical Express	+353-(0)1-8438573	Pat	No
Chemical & Nutritional Supplies	+353-(0)86-2417525		No
Chemical Resistant Inst.	+353-(0)1-8353228		No
Chemical Solutions			No response
Chemicals and Plastics Ltd	+353-(0)1-6685193		No
Chemifloc Ltd	+353-(0)61-708699		No
Chemtek Sales Ltd	+353-(0)1-8453766		No

List of chemical manufacturers and suppliers of methyl bromide (sourced from the Golden Pages) *contd.*

Name	Contact no.	Contact name	Produce or supply MB
Classic Chem (Classic Solutions) Ltd	+353-(0)21-4316519		No
Corcoran Chemicals Ltd	+353-(0)1-6778163	Patricia Magee	No
Crowley Chemicals Ltd	+353-(0)21-4962288	Dan	No
DHM Agrochemicals Ltd	+353-(0)1-2952377	Dennis	No
Dowling Chemical Systems	+353-(0)59-9146336	Clive Matthews	No
ECI European Chemicals	+353-(0)42-9740607		No
Environmental Export Irl Ltd	Number invalid		No response
Federation of Irish Chemical Industries			No
Findale Chemicals Ltd	+353-(0)42-9371456	Mark	No
Foran Chemicals Ltd	+353-(0)1-6233728	Dr Sharma	No
Forum Chemicals (IRE) Ltd	+353-(0)1-4511266		No
Gannon Chemicals Ltd	+353-(0)94-9364011	Paul	No response
General Chemicals Ltd	+353-(0)1-6283391		No
Gilabbey Chemicals Ltd	+353-(0)21-4361811		No
Glaxo SmithKline Beecham	+353-(0)21-4378800	Ian McAuliffe	No
Goulding Chemicals Ltd	+353-(0)1-6121314	Alberta	No
Helsinn Chemicals Irl Ltd	+353-(0)1-8206111	David	No
Independent Laboratory Ltd	+353-(0)1-2401374		No response
Industrial Chemical Ltd	+353-(0)1-2842722		No
Interchem Ltd	+353-(0)1-6267211		No
Irish Ceca Ltd	+353-(0)45-870855		No
Janchem Ltd	+353-(0)1-4925830	John	No
Janssen Pharmaceutical Ltd	+353-(0)21-4353321	Niamh Hunt	No
J & G Chemicals Ltd	+353-(0)61-390045		No
J & T Chemicals	+353-(0)21-7331811		No
KB Scientific	+353-(0)21-4965441	Tim Goulding	No response
Keelan Chemicals Ltd	+353-(0)21-4292968		No
Kilco Chemicals Ireland Ltd	+353-(0)1-4780335	David Martin	No
Kilroy Agricultural Services Ltd	+353-(0)56-7722749		No
Knights Industrial Ltd	+353-(0)1-4559511		No response
Matthews Agricultural Services Ltd	+353-(0)41-9826287	Michelle	No
Microlabs Ltd	+353-(0)42-9746653		No response
Moynihan & Moynihan Chemicals	+353-(0)21-4364738		No
Murphy Pat Industrial Sales & Service Ltd	+353-(0)21-4354188		No
National Agrochemical Distributors	+353-(0)1-6282492		Yes – distribute
Neptune Laboratory Services Ltd	+353-(0)91-758484	Sheila	No
North Chemicals Ltd	+353-(0)1-8446150		No
North East Chemicals	+353-(0)41-9835775		No response
Ocon Chemicals Ltd	+353-(0)21-4318555		No
Oldcastle Laboratories Ltd	+353-(0)49-8541160		No response
Pfizer Pharmaceutical Prod. Corp	+353-(0)21-4378788	Collette Herbert	No
Pied Piper Chemical Co. Ltd	+353-(0)52-56422		No
P-K Chemicals Ltd	+353-(0)1-2956977		No
Power & Chemical Plant Ltd	+353-(0)45-864146		No response
PR EuroCHEM Ltd	+353-(0)21-4212146		No
Rhone-Poulenc Ireland Ltd	+353-(0)1-4514244		No response
Roschem Products Ltd	+353-(0)71-9635375		No

List of chemical manufacturers and suppliers of methyl bromide (sourced from the Golden Pages) *contd.*

Name	Contact no.	Contact name	Produce or supply MB
Rycal Chemicals Distributors	+353-(0)29-58115	Claire	No
Schlotter	+353-(0)45-447400		No
Scientific & Chemical Supplies Ltd	+353-(0)21-4882388		No
Shearwater Distribution Ltd	+353-(0)1-4737035		No
Solchem Ltd	+353-(0)61-707430		No
Soltec (Ireland) Ltd	+353-(0)44-42008	Corcoran	No
South-Eastern Chemicals Ltd	+353-(0)51-885405	Frank Comber	No
Southern Scientific Services	+353-(0)64-33922	Kate	No response
Standard Chemicals Ltd	+353-(0)51-878600		No response
Sullchem Hygiene & Chemical Products	+353-(0)21-4775481		No response
Surfachem International Ltd	+353-(0)1-7979090		No response
Unichem Ltd	+353-(0)1-8351499		No
Univar Ireland Ltd	+353-(0)1-6282888		No
Wacker Chemicals Ltd	+44-1784487814	Beverly McCormac	No
Water Testing Laboratories	+353-(0)46-9028920		No response

Pest control companies contacted during the survey (information sourced from the Irish Pest Control Association).

Pest control firm	Phone no	Contact details	Use of methyl bromide
Arrest-A-Pest	+353-(0)21-4346056		Yes
Owl Pest Control	+353-(0)1-4298954	Patrick	No
Combal Ltd	+353-(0)1-623 6016	Mr Proctor	No
Aardvark Pest Control	+353-(0)1-8257698	Mr Lynch	No
Premier Pest Control	+353-(0)86-2695050	Brendan	No
EnviroKare Environmental Services	+353-(0)74-9136030	Sean McCauliffe	No
Donegal Pest Control	+353-(0)74-9734209	Mr Magee	No
Sorex Ltd	+44-151-4207151	Ms Wilson	No
ISS Hygiene Services	+353-(0)21-4822185	Mr Gilley	Yes
Spray-Chem Ltd	+353-(0)1-8309099	Mr Lyons	No
KAS Sales	+353-(0)1-2988689	Mr Dodd	No response
Fingal Pest Control	+353-(0)1-8404993	Mr Lee	No
A OK's Pest Control Services	+353-(0)90-6625639	Mr O'Keefe	No
Pest-A-Tac	+353-(0)21-4316406	Mr Grant	No
Vaughan & Sons	+353-(0)1-4943111	Mr Vaughan	No response
Pestkill Ltd	+353-(0)86-8130655	Mr Teehan	Yes
Paddy Dowd	+353-(0)87-8230991	Mr Dowd	No
Euroex Pest Control	+353-(0)87-2264056	Mr Cunningham	No
Southwest Pest Control	+353-(0)21-4885353	Mr Sheehan	No
Pest Guard	+353-(0)1-4587722	Mr O'Toole	No response
Terminex (Ecolab)	+353-(0)1-801 4007	Gary Jones	Yes
Rentokill	+353-(0)1-4902788	Mike O'Mahony	No – historically did
Enniskeane Timber	+353-(0)23-47333	Jerry O'Flynn	Yes

Appendix D General Guidance for Halon Technicians and Users

D.1 Safety in Halon Decommissioning

A number of documents provide guidance on safety aspects of halon decommissioning including UNEP (1999), EU Commission (2000) and UNEP (2001). The summary data provided below are drawn from these publications.

Halons are stored under pressure in cylinders. Release of the pressurised gas in an uncontrolled way can have significant impact, both environmental and also from a health and safety perspective. A number of incidents have been reported in other countries in relation to accidental discharge during removal or handling of halon cylinders. It is reported that in all cases the cause was improper handling of the cylinders by untrained and unqualified people.

The following guidance on halon decommissioning is taken from the guidance documents referenced above, further detail is available in these documents:

1. Secure cylinder

The cylinder should be firmly secured to an immovable object prior to disconnecting any piping. Most cylinders installed as part of fixed systems are normally adequately secured.

2. Disable actuation device

Once secured the actuation device should be disabled to prevent accidental release of the cylinder contents. Different systems will have different types of actuation devices, and different measures will be required to render them completely disabled. Reference should be made to operation and maintenance manuals provided with the system to ensure that the actuation device is fully disabled.

3. Install anti-recoil device

An anti-recoil device prevents the cylinder from becoming a projectile in the event that the cylinder activates or if the valve becomes damaged. Anti-recoil devices should be installed at all times, except when the cylinders are connected to the piping system, or are being filled. Anti-recoil devices should be installed before handling the cylinder.

Once the safety devices are in place the cylinder can be moved with relative safety. The gas is still stored under pressure and should be handled carefully.

D.2 Guidance for Critical Users – Controlling Halon Emissions and Leak Detection

In terms of managing halons in ongoing uses (i.e. critical users) the EU Commission (EU Commission, 2000) gives the following general comments on avoiding accidental halon discharge:

- Reducing or eliminating altogether commissioning and maintenance tests, the largest cause of halon emissions
- Avoiding carelessness by end-users when, for example, fire-detection systems are accidentally triggered by smoke or heat from an activity carried out in close proximity to the detection mechanism
- Avoiding poor handling by service engineers that cause halons to be accidentally released when the extinguishing systems are not locked off or placed on manual before testing
- Ensuring sufficient system maintenance in order to avoid accidental discharges caused by a malfunction of the detection system.

Guidance for critical users in given by UNEP (UNEP, 2001) and includes coverage of the following issues:

- Halon use, alternatives and inventory management by the aviation sector
- Safety in halon decommissioning
- Military applications and halon management.

Methods available for leak detection and minimisation include:

- Regular inspection and recording of cylinder condition and pressure
- Install monitoring systems in rooms containing fire system to monitor airborne gas concentrations
- Pressure testing of cylinders on a regular (e.g. every 4 years) basis to check integrity of cylinder
- Automated monitoring of cylinder pressure and alarm at pre-set pressure drop.

Appendix E Methyl Bromide Training Contacts List

- British Pest Control Association Training: www.bpca.org.uk/training/fumigation.htm
- Irish Pest Control Association Training: http://www.bpca.org.uk/ipca/training.htm
- British Pest Control Association/Irish Pest Control Association
  Gleneagles House
  Vernongate Derby
  DE1 1UP
  England
  Tel.: +44-1332-294288 or +44-1332-225105

Appendix F ODS Solvents Contact List

Chemical manufacturers and suppliers (sourced from the Golden Pages).

Name	Contact no.	Contact name	Produce/supply 1,1,1 trichloroethane	Produce/supply carbon tetrachloride
Abbey Chemicals	+353-(0)46-9022975		No	No
Absolutions Food Safety	+353-(0)87-2029040		No	No
Action Clean	+353-(0)87-2577639		No	No
ADM Ringaskiddy	+353-(0)21-4378901	John White	No	No
Advance Chemicals	+353-(0)1-8301933		No	No
Agricultural Chemical	+353-(0)61-385226		Distribute	No
Agru Irl Ltd	+353-(0)51- 379474		No	No
Air Products Ireland Ltd.	+353-(0)1-8455111		No	No
Aire Laboratories Ltd	+353-(0)25-39024		No	No
Albion Chemical Distribution (IRL) Ltd	+353-(0)1-4600360		No	No
Alman Chemical Co.	+353-(0)90-9741028		No	No
Anachem	+353-(0)21-4373175		No	No
Antech Ltd	+353-(0)51-392391		No	No
Applied Chemex	1890-924524		No	No
Applied Chemicals Ireland Ltd	+353-(0)1-4600977		No response	No
Arch Chemicals BV	+353-(0)1-8908000		No	No
Arco Industrial Supply	+353-(0)1-8880900		No	No
Arran Chemical Co. Ltd	+353-(0)90-6595807	Fiona/Peter	No	No
Arrest-A-Pest	+353-(0)52-21563	Nollagh/Pat	No	No
Ashland Chemicals & Hygiene Supplies Ltd	+353-(0)48-77767007	Mr Ashfield	No	No
Aughinish Alumina Ltd	+353-(0)61-604000	Bernard Loughlin	No	No
BASF Ireland Limited	+44-161-4885176	Peter Layton	No	No
Bayer Crop Science	+353-(0)1-8132255		No	No
Bayer Ltd	+353-(0)1-8132222		No	No
Best Chemicals Ltd	+353-(0)51-396888		No	No
Biachem Europe (Distribution) Ltd	+353-(0)59-9136930		No	No
Biocel	+353-(0)21-4353516	Donal O'Dubghain	No	No
Bray Chemicals	Number invalid		-	No
Breen Chemicals Ltd	+353-(0)54-66500		No	No
C & G Logistic Group	+353-(0)1-8208455		No	No
Camida	+353-(0)52-25455	Yvonne Mullins	No	No
Cedele	+44-78-70558636 +44-1782-596867	Cathy McFall Maurene Bennett	No	No
Central Chemical Supplies Ireland Ltd	+353-(0)1-8332281		No response	No response
Chembrite (Ireland) Ltd	+353-(0)71-9641967		Use	No
Chemco (Ireland) Ltd	+353-(0)1-4569761		No	No
Chemcraft Industries Ltd	+353-(0)1-4976888		No	No
Chemical Analysis Laboratory	+353-(0)1-2360755		No	No
Chemical Direct Ltd	+353-(0)1-8118920		No	No
Chemical Express	+353-(0)1-8438573	Pat	No	No
Chemical & Nutritional Supplies	+353-(0)86-2417525		No	No

Chemical manufacturers and suppliers (sourced from the Golden Pages).

Name	Contact no.	Contact name	Produce/supply 1,1,1 trichloroethane	Produce/supply carbon tetrachloride
Chemical Resistant Inst.	+353-(0)1-8353228		No	No
Chemical Solutions			No response	No response
Chemicals and Plastics Ltd	+353-(0)1-6685193		No	No
Chemifloc Ltd	+353-(0)61-708699		No	No
Chemtek Sales Ltd	+353-(0)1-8453766		No	No
Classic Chem (Classic Solutions) Ltd	+353-(0)21-4316519		No	No
Corcoran Chemicals Ltd	+353-(0)1-6778163	Patricia Magee	No	No
Crowley Chemicals Ltd	+353-(0)21-4962288	Dan	No	No
DHM Agrochemicals Ltd	+353-(0)1-2952377	Dennis	No	No
Dowling Chemical Systems	+353-(0)59-9146336	Clive Matthews	No	No
ECI European Chemicals	+353-(0)42-9740607		No	No
Environmental Export Irl Ltd	Number invalid		No response	No response
Federation of Irish Chemical Industries			No	No
Findale Chemicals Ltd	+353-(0)42-9371456	Mark	No	No
Foran Chemicals Ltd	+353-(0)1-6233728	Dr Sharma	No	No
Forum Chemicals (IRE) Ltd	+353-(0)1-4511266		No	No
Gannon Chemicals Ltd	+353-(0)94-9364011	Paul	No response	No response
General Chemicals Ltd	+353-(0)1-6283391		No	
Gilabbey Chemicals Ltd	+353-(0)21-4361811		No	No
Glaxo SmithKilne Beecham	+353-(0)21-4378800	Ian McAuliffe	No	No
Goulding Chemicals Ltd	+353-(0)1-6121314	Alberta	No	No
Helsinn Chemicals Irl Ltd	+353-(0)1-8206111	David	No	No
Independent Laboratory Ltd	+353-(0)1-2401374		No response	No response
Industrial Chemical Ltd	+353-(0)1-2842722		No	No
Interchem Ltd	+353-(0)1-6267211		No	No
Irish Ceca Ltd	+353-(0)45-870855		No	No
Janchem Ltd	+353-(0)1-4925830	John	No	No
Janssen Pharmaceutical Ltd	+353-(0)21-4353321	Niamh Hunt	No	No
J & G Chemicals Ltd	+353-(0)61-390045		No	No
J & T Chemicals	+353-(0)21-7331811		No	No
K B Scientific	+353-(0)21-4965441	Tim Goulding	No response	No response
Keelan Chemicals Ltd	+353-(0)21-4292968		No	No
Kilco Chemicals Ireland Ltd	+353-(0)1-4780335	David Martin	No	No
Kilroy Agricultural Services Ltd	+353-(0)56-7722749		No	No
Knights Industrial Ltd	+353-(0)1-4559511		No response	No response
Matthews Agricultural Services Ltd	+353-(0)41-9826287	Michelle	No	No
Microlabs Ltd	+353-(0)42-9746653		No response	No response
Moynihan & Moynihan Chemicals	+353-(0)21-4364738		No	No
Murphy Pat Industrial Sales & Service Ltd	+353-(0)21-4354188		No	No
National Chemical Company	+353-(0)1-6282492		No	No
Neptune Laboratory Services Ltd	+353-(0)91-758484	Sheila	No	No
North Chemicals Ltd	+353-(0)1-8446150		No	No
North East Chemicals	+353-(0)41-9835775		No response	
Ocon Chemicals Ltd	+353-(0)21-4318555		Distribute	Distribute
Oldcastle Laboratories Ltd	+353-(0)49-8541160		Distribute	Distribute

Chemical manufacturers and suppliers (sourced from the Golden Pages).

Name	Contact no.	Contact name	Produce/supply 1,1,1 trichloroethane	Produce/supply carbon tetrachloride
Pfizer Pharmaceutical Prod. Corp	+353-(0)21-4378788	Collette Herbert	No	No
Pied Piper Chemical Co. Ltd	+353-(0)52-56422		No	No
P-K Chemicals Ltd	+353-(0)1-2956977		No	No
Power & Chemical Plant Ltd	+353-(0)45-864146		No response	No response
PR EuroCHEM Ltd	+353-(0)21-4212146		No	No
Rhone-Poulenc Ireland Ltd	+353-(0)1-4514244		No response	No response
Roschem Products Ltd	+353-(0)71-9635375		No	No
Rycal Chemicals Distributors	+353-(0)29-58115	Claire	No	No
Schlotter	+353-(0)45-447400		No	No
Scientific & Chemical Supplies Ltd	+353-(0)21-4882388		No	No
Shearwater Distribution Ltd	+353-(0)1-4737035		No	No
Solchem Ltd	+353-(0)61-707430		No	No
Soltec (Ireland) Ltd	+353-(0)44-42008	Corcoran	No	No
South-Eastern Chemicals Ltd	+353-(0)51-885405	Frank Comber	No	No
Southern Scientific Services	+353-(0)64-33922	Kate	No response	No response
Standard Chemicals Ltd	+353-(0)51-878600		No response	No response
Sullchem Hygiene & Chemical Products	+353-(0)21-4775481		No response	No response
Surfachem International Ltd	+353-(0)1-7979090		No response	No response
Unichem Ltd	+353-(0)1-8351499		No	No
Univar Ireland Ltd	+353-(0)1-6282888		No	No
Wacker Chemicals Ltd	+44-1784487814	Beverly McCormac	No	No
Water Testing Laboratories	+353-(0)46-9028920		No response	No response

Appendix G Manufacturers of Abatement Equipment

- ABB Fläkt http://www.abb.com
- Alstom http://www.alstom.com
- CNIM
- FLS Miljö http://www.flsmiljo.com/
- LAB
- LGI
- Lurgi http://www.lurgi.com
- NPI
- Procedair http://www.solios.com/
- Stein http://www.bulk-online.com

A non-exhaustive list of companies offering active carbon is as follows:

- CECA http://www.ceca.fr/ceca/fr/f_elf.cfm
- Chemviron http://www.chemvironcarbon.com/
- Norit http://www.norit.com/index.html
- Sifat

Appendix H Example of Manufacturer Guidelines for Methyl Bromide Handling

Taken from the Great Lakes website
http://www.e1.greatlakes.com

RESTRICTED USE PESTICIDE
DUE TO ACUTE TOXICITY
For retail sale to and use only by Certified Applicators or persons under their direct supervision, and only for those uses covered by the Certified Applicator's certification.

DIRECTIONS FOR USE OF THE PRODUCT

METH-O-GAS® 100 COMMODITY FUMIGANT

EPA REGISTRATION NUMBER
5785-11

DANGER **PELIGRO**

Si Usted no entiende la etiqueta, busque a alguien para que se la explique a Usted in detalle. (If you do not understand the label, find someone to explain it to you in detail.)

READ THIS BOOKLET AND ENTIRE LABEL CAREFULLY PRIOR TO USE. USE THIS PRODUCT ACCORDING TO LABEL INSTRUCTIONS.

Great Lakes CHEMICAL CORPORATION
P.O. BOX 2200
WEST LAFAYETTE, IN 47996-2200
U.S.A.

MOG100-10 REV.GLK159F

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1

STATEMENT OF WARRANTY AND LIABILITY

Seller warrants that this product complies with the specifications expressed in this label. SELLER MAKES NO OTHER WARRANTIES; AND DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY AND FITNESS FOR THE INTENDED PURPOSE. Seller's liability for default, breach, or failure under this label shall be limited to the amount of the purchase price. Seller shall have no liability for consequential damages.

Many pesticidal chemicals are poisonous and may leave a toxic residue on the plants to which they are applied. The U.S. Environmental Protection Agency has established maximum amounts of such pesticidal chemicals that may remain on raw agricultural products, and it is the user's responsibility to see that there is no residue on such crops in excess of these amounts. The "Directions for Use" are based on the best available information, and if followed carefully should not leave excessive residues. However, Great Lakes Chemical Corporation assumes no responsibility as to their accuracy nor for any loss due to excessive residues.

2

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS
DANGER

Extremely hazardous liquid and vapor under pressure. Liquid or vapor can cause serious skin or eye injury which may have a delayed onset. Do not get liquid on skin, in eyes or on clothing.

Do not breathe vapor. Inhalation may be fatal or cause serious acute illness or delayed lung or nervous system injury. Methyl bromide vapor is odorless and nonirritating to skin and eyes during exposure. Exposure to toxic levels may occur without warning or detection by the user.

AIR CONCENTRATION LEVEL

The acceptable air concentration level for persons exposed to methyl bromide is **5 ppm (20 mg/m³)**. The air concentration level is measured by a direct reading detection device, such as a Matheson-Kitagawa, Draeger, or Sensidyne.

3

AERATION AND REENTRY

After fumigation, treated areas must be aerated until the level of methyl bromide is **5 ppm** or less. Do not allow entry into the treated area by any person before this time, unless protective clothing and a respiratory protection device (NIOSH/MSHA approved self-contained breathing apparatus (SCBA) or combination air-supplied/SCBA respirator) is worn.

PERSONAL PROTECTIVE EQUIPMENT (PPE)
Applicators and other handlers must wear:
Loose-fitting or well ventilated long-sleeved shirt and long pants.
Shoes and socks.
Full-face shield or safety glasses with brow and temple shields (Do NOT wear goggles). When the acceptable air concentration level is above **5 ppm** and a respirator is required, protect the eyes by wearing a full-face respirator.

No respirator is required if the air concentration level of methyl bromide in the working area is measured to be **5 ppm** or less.
A respirator is required if the acceptable air concentration level of **5 ppm** is exceeded at any time. The respirator must be one of the following types: (a) a supplied-air respirator (MSHA/NIOSH approval number prefix TC-19C) OR (b) a self-contained breathing apparatus (SCBA) (MSHA/NIOSH approval number prefix TC-13F).

WORK SAFETY REQUIREMENTS

1. Do not wear jewelry, gloves, goggles, tight clothing, rubber protective clothing, or rubber boots when handling. Methyl bromide is heavier than air and can be trapped inside clothing and cause skin injury.
2. If liquid fumigant splashes or spills on clothing or shoes, remove them at once.
3. Immediately after contamination remove outer clothing, shoes, and socks and do not reuse until thoroughly aerated or ventilated. Keep such clothing and shoes outdoors until thoroughly aerated. Then follow the PPE manufacturers instructions for cleaning/maintaining PPE. If there are no such instructions for washables, use detergent and hot water. Keep and wash PPE and work clothing separately from other laundry.
4. Discard clothing, shoes and other absorbent materials that have been drenched or heavily contaminated with this product. Do not reuse them.
5. Follow PPE manufacturer's instructions for cleaning/maintaining protective eyewear and respirators.

USER SAFETY RECOMMENDATIONS
Users should:
* Wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
* Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.
* Remove PPE immediately after handling this product. As soon as possible, wash thoroughly and change into clean clothing.

4

FIRST AID	
If inhaled	• Move person to fresh air. Keep warm. • If person is not breathing, call 911 or an ambulance, then give artificial respiration, preferably by mouth-to-mouth, if possible. • Do not give anything by mouth to an unconscious person. If not unconscious, rinse mouth out with water. • In all cases of overexposure, get medical attention immediately. Take person to a doctor or emergency treatment facility.
If on skin	• Immediately remove contaminated clothing, or clothing shoes, and any other item on skin. • Rinse skin immediately with plenty of water for 15-20 minutes. • In all cases of overexposure, get medical attention immediately. Take person to a doctor or emergency treatment facility.
If in eyes	• Hold eye open and rinse slowly and gently with water for 15-20 minutes. • Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye. • In all cases of overexposure, get medical attention immediately. Take person to a doctor or emergency treatment facility.

HOT LINE NUMBER

Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-949-5167 for emergency treatment information.

NOTE TO PHYSICIAN

Early symptoms of overexposure are dizziness, headache, nausea and vomiting, weakness and collapse. Lung edema may develop in 2 to 48 hours after exposure, accompanied by cardiac irregularities; these effects are the usual cause of death. Repeated overexposures can result in blurred vision, staggering gait and mental imbalance, with probable recovery after a period of no exposure. Blood bromide levels suggest the occurrence, but not the degree, of exposure. Treatment is symptomatic.

ENVIRONMENTAL HAZARDS

This product is toxic to fish and wildlife. Keep out of lakes, streams and ponds. Do not contaminate water by cleaning of equipment or disposal of wastes.

SPILL AND LEAK PROCEDURES.
Evacuate immediate area of spill or leak. Use a NIOSH/MSHA approved self-contained breathing apparatus (SCBA) or combination air-supplied/SCBA respirator for entry into affected area to correct problem. Allow spill to evaporate. Do not permit entry into spill area by persons without appropriate respiratory protection until concentration of methyl bromide is determined to be **5 ppm** or less. Remove leaking containers to an isolated area and cover with a polyethylene sheeting of 4 mil or greater thickness. Seal by placing the outside edges of sheeting in a trench and cover with soil. Tamp soil down so edges will not pull loose. Discharge the contents under the sheeting and do not disturb for at least 48 hours.

Contaminated soil, water, and other cleanup debris is a toxic hazardous waste. Report spill to the National Response Center (800-424-8802) if the reportable quantity of 1000 pounds is exceeded.

PHYSICAL AND CHEMICAL HAZARDS

Contents under pressure. Do not use or store near heat or open flame. In fires fueled by other materials, Meth-O-Gas® 100 may liberate hazardous gases. Meth-O-Gas® 100, used as a gaseous fumigant, is generally non-corrosive under dry conditions. However, the use of liquid methyl bromide with aluminum, magnesium, zinc and alkali metals may result in the liberation of toxic gases, and possible fire and explosion. In addition, the use of liquid methyl bromide may cause severe corrosion of containers and equipment made of these metals.

DIRECTIONS FOR USE

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

This fumigant is a highly hazardous material and must be used only by individuals trained in its proper use. Before using, you must read and obey all label precautions and directions.

All persons working with this fumigant must be knowledgeable about the hazards, and trained in the use of required respiratory protection equipment and detector devices, emergency procedures, and proper use of the fumigant.

THIS PRODUCT IS TO BE USED for control of pests in stored or residual food products, agricultural commodities and other materials and products as specified on this label. This product is to be used for these purposes **ONLY IN**: (a) enclosed spaces and structures that are intended or used for processing, transportation, handling, or storage of food products, agricultural commodities or other materials and products identified on this label; (b) enclosed spaces and structures in which food products, agricultural commodities, or other materials and products identified on this label have been processed, transported, handled or stored; and, when this product is used for the foregoing purposes, (c) associated storage areas, work areas, and food service facilities (such as employee cafeterias and test kitchens). **DO NOT USE THIS PRODUCT IN** residential structures or in food service facilities (such as public restaurants) other than those described above, or for any purposes other than those described above.

If you have any questions about the proper use of this product, you should contact Great Lakes Chemical Corporation at 1-800-378-9451 before using this product.

STORAGE, HANDLING AND DISPOSAL

Storage and Handling of Cylinders. Store in a secure manner either outdoors under ambient conditions or indoors in a well-ventilated area. Post as a pesticide storage area.

Do not contaminate water, food, or feed by storage. Store cylinders upright, secured to prevent tipping, as allowed by design.

Cylinders should not be subjected to rough handling or mechanical shock such as dropping, bumping, dragging, or sliding. Do not use rope slings, hooks, tongs or similar devices to unload cylinders. Transport cylinders using hand truck, fork truck or other device to which the cylinder can be firmly secured. Do not remove valve protection bonnet and safety cap until immediately before use. Replace safety cap and valve protection bonnet when cylinder is not in use.

When cylinder is empty, close valve, screw safety cap on to valve outlet, and replace protection bonnet before returning. Only the registrant, or his designee, is authorized to refill cylinders. Do not use cylinders for any other purpose.

Storage and Handling of Cans. Store 1.5 pound cans indoors in a locked, dry, well-ventilated area. Do not attempt to store partially emptied cans. Keep empty cans in a well-ventilated location for at least 12 hours before disposal. Do not reuse empty cans.

Disposal of Pesticide. Pesticide wastes are toxic. Improper disposal of excess pesticide is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Disposal of Cylinders. To insure proper return of empty or partial cylinders, make return shipping arrangements with the seller of the product.

Disposal of Cans. Before disposal, empty the can by using the product according to the label. Keep empty cans in a well-ventilated location for at least 12 hours before disposal. Cans can be recycled in some recycling centers. Otherwise, dispose of empty cans in a sanitary landfill, or by other procedures approved by state and local authorities.

COMMODITY, FOOD, AND FEED FUMIGATION DIRECTIONS.
THE FOLLOWING PRECAUTIONARY PROCEDURES MUST BE FOLLOWED FOR ALL USES.

When used for fumigation of enclosed spaces (e.g., warehouses, grain bins or elevators, vaults, chambers, trucks, vans, railroad cars, ships, and other transport vehicles, and tarpaulin-covered commodities), two persons trained in the use of this product must be present during introduction of the fumigant, initiation of aeration, and after aeration when testing for reentry. Two persons do not need to be present if application, aeration, monitoring and/or testing is conducted remotely (outside the area being fumigated).

Do not fumigate with this product when the space, commodity, or structure (excluding dwellings) to be fumigated is below 40ºF for control of insects or below 20ºF for control of rodents and other warm-blooded pests. At temperatures below 60°F, an approved procedure to heat the fumigant should be used.

If monitoring indicates concentration of fumigant is insufficient to be effective for the target pest, additional fumigant may be added as required; but, concentration is not to exceed prescribed rates of application.

When fumigating tanks, silos, etc., of stored bulk flour, empty or draw down flour to less than one-half meter deep. Do not introduce liquid methyl bromide into flour storages. Set up fans or air circulation to avoid localized high concentrations of methyl bromide when shooting gaseous methyl bromide into the storage. Do not overdose flour storages. It is recommended that the fumigant be applied outside flour storages that are inside buildings and allowed to drift in through open hatches.

PLACARDING OF FUMIGATED AREAS

The applicator (or supervisor of the application) must placard all entrances to the fumigated area with signs bearing:

- skull and crossbones symbol.
- "DANGER/PELIGRO,".
- "Area under fumigation, DO NOT ENTER/NO ENTRE,"
- "Methyl Bromide Fumigant in use,"
- the date and time of fumigation, and
- name, address, and telephone number of the applicator.

Do not allow entry by unprotected persons into the fumigated area until the signs are removed. Do not remove warning signs until the fumigated area and the treated commodity are completely aerated. To determine whether aeration is complete, each fumigated site or vehicle must be tested and shown to contain **5 ppm** or less of methyl bromide in the airspace around and, when feasible, in the mass of the commodity. If **5 ppm** or less of methyl bromide is detected, the warning sign may be removed. However, if greater than **5 ppm** of methyl bromide is detected, the warning signs must be transferred with the commodity to the new site. Workers who transfer or handle incompletely aerated commodity must be informed and appropriate measures must be taken (i.e. ventilation or respiratory protection) to prevent exposures from exceeding **5 ppm** of methyl bromide.

A. Chamber and Vault Fumigation. **8**

All precautionary procedures as outlined immediately following COMMODITY, FOOD, AND FEED FUMIGATION DIRECTIONS must be followed.

Load the chamber with the material to be fumigated, close exhaust ports, turn on circulating fan and close chamber door. Determine the proper rate of application and exposure time from appropriate table. Introduce the fumigant into the chamber by releasing it into the air stream in front of a blower or fan, passing it through a vaporizer, or allowing it to evaporate from a shallow pan. All controls should be outside the chamber.

At the end of the exposure period, aerate by opening the exhaust port, turning on the exhaust fan and opening the chamber door slightly or an inlet port to permit fresh air to enter. At the end of the aeration period, check fumigant concentration with a detection device. See Aeration and Reentry Section.

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B. Vacuum Chamber Fumigation.

All precautionary procedures as outlined immediately following COMMODITY, FOOD, AND FEED FUMIGATION DIRECTIONS, must be followed.

Place articles to be fumigated in the steel chamber and draw the vacuum (25-27 inches mercury). Release fumigant into the chamber (usually through an appropriate heating unit to insure complete non-destructive vaporization of methyl bromide). See appropriate table for rates of application and exposure times. At the end of the exposure time, release the vacuum and change the air in the chamber at least two times. A vacuum of 15 inches mercury should be drawn for this purpose. After purging chamber, check fumigant concentration with a detection device. See Aeration and Reentry Section.

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C. Railroad Car, Truck, Van, Trailer or Air and Sea Container Fumigation.

All precautionary procedures as outlined immediately following COMMODITY, FOOD, AND FEED FUMIGATION DIRECTIONS, must be followed.

Railroad car should be placed on seldom used trackage or siding so that it will not have to be moved while under fumigation. Park vehicle or container out of traffic area; if possible on the lee side of a building to protect from winds. Do not fumigate while strong winds are blowing. Seal the doors, ventilators and other openings. If vehicle or container can not be adequately sealed, cover with tarpaulin or plastic sheeting. See Tarpaulin Fumigation Section.

The end(s) of the shooting line(s) should be anchored inside an evaporation pan unless a volatizer is used to apply gaseous fumigant. Use a fan or blower to aid in even distribution of the fumigant. Always apply fumigant from outside the vehicle. Place warning signs on doors and as needed to be easily visible. Secure or lock vehicle or container to ensure it is not moved before aeration. **DO NOT FUMIGATE VEHICLES IN TRANSIT.**

Consult appropriate table for specific articles, rates of application and exposure times.

After the appropriate exposure period, open the unit and aerate at least one hour. The vehicle must be aerated to **5 ppm** or less before movement is allowed. The vehicle may then be resealed for shipment. See Aeration and Reentry Section.

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D. **Tarpaulin Fumigation.**

All precautionary procedures as outlined immediately following COMMODITY, FOOD, AND FEED FUMIGATION DIRECTIONS, must be followed.

The article or stacked articles should be placed on a concrete floor or other air-tight surface. If the floor or surface is not air-tight, it may be made so by sealing or covering it with additional tarpaulin or polyethylene sheeting. Provide a space on top of the stack for a gas expansion dome to facilitate distribution. Evaporating pans are essential for the volatilization and uniform dispersion of fumigant except where a vaporizer is used. Shallow pans or basins made of plastic or metal (except aluminum) are satisfactory for this purpose. Use one evaporator pan for each 1000 cubic feet contained under the tarp. For delivery of *Meth-O-Gas® 100* from outside the tarpaulin, do not use polyvinyl tubing; polyethylene tubing is recommended. Anchor one end of each tube into an evaporating pan with tape or a suitable weight. This ensures that the liquid will be directed into the evaporating pan. Place evaporating pan(s) with anchored applicator tubing in the center of the expansion dome. Extend the free ends of the polyethylene tubes outside the area to be covered. Cover and seal the stack with a gas tight tarpaulin or polyethylene sheeting of 4 mil or greater thickness. Allow a margin of at least two feet at the base of the stack for sealing. Sweep around the stack to provide a clean surface for sealing the tarpaulin. Seal tarpaulin to floor by sand and/or water snakes, by taping or by means of moist soil or sand.

Attach each polyethylene tube to a can applicator or cylinder valve outlet and release fumigant. Use a cylinder dispenser or scale to meter small amounts from cylinders. A combination opener-evaporating pan is available for use with 1.5 pound cans under a tarpaulin. Fans normally should be used in tarp fumigations to aid in the even distribution of fumigant. A vaporizer or heat exchanger may be required and is also useful to aid in application and distribution of the fumigant. Dosage rates and exposure times are shown in Tables I through III. At the end of the exposure period, unseal opposite ends of the tarpaulin and allow to aerate for at least one hour before completely removing the tarp. Check fumigant concentration with a detection device before allowing unprotected persons to enter the area. See Aeration and Reentry Section.

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E. **Warehouse, Grain Elevator, Food Processing Plant, And Other Structures Containing Listed Commodities and Materials.**

All precautionary procedures as outlined immediately following COMMODITY, FOOD, AND FEED FUMIGATION DIRECTIONS, must be followed.

Check with appropriate municipal and county authorities before fumigating to be completely familiar with local regulations. Ordinances may require watchmen or locks, during fumigation and/or notification of the nearest fire station.

1. **Preparation for Fumigation.** Remove or protect the following items from the structure to be fumigated: 1) all food and feed commodities not included in Tables I or II; 2) medicinals not sealed in metal or glass; 3) pets (including fish and birds); 4) furs, horsehair articles, and leather goods sensitive to methyl bromide; 5) rubber goods (natural latex); 6) carbonless carbon forms and blueprints; 7) cinder blocks; 8) articles containing sulfur; 9) seeds, bulbs, and live plants; 10) live cultures; 11) wool and woolen articles.

   Prior to fumigation, extinguish all open flames and turn off all high temperature electrical equipment including laboratory ovens, pilot lights, gas refrigerators, oil burners, etc. *Meth-O-Gas® 100* in the presence of intense heat from such sources may generate some hydrobromic acid which may be injurious to commodities and equipment.

2. **Sealing the Building.** The most important part of the fumigation is the preparation and sealing of the structure. A thorough sealing job is necessary. Avoid fumigating under windy conditions.

   Sealing of the building begins with the closing of all external openings to the building. Wrap roof ventilators, chimneys and other large openings with a tarpaulin or plastic sheet and seal with duct or other appropriate tape. Screened and small openings may also be sealed with a wide, commercial duct or masking tape. Cleaning of the surfaces to be taped and the use of commercial spray-on adhesives will improve sealing.

   For masonry or metal structures, seal all cracks and other air leaks with caulking material or tape, and seal cracks around doors, windows, vents and other openings. Wooden structures and others that can not be readily sealed may be completely enveloped with an impervious tarpaulin. Seal securely all seams between tarps and seal the lower edges of the tarp to the ground with moist soil or with sand or water snakes. To prevent escape of gas through the ground and avoid injury to nearby plants, wet the soil to a depth of six inches for a distance of one foot outward from the edge of the tarp.

   Exterior doors and windows should be tightly sealed and locked. Large exterior doors may require additional efforts to seal properly. Check for cracks around the eaves, in the floor and roof, and seal them.

   Storage or work areas in a building that are not to be fumigated should be carefully sealed off. Adjoining buildings sharing a common wall should be cleared of occupants before fumigation. If this is not feasible, seal with a gas tight tarp or polyethylene sheeting (thickness of 4 ml or greater) to prevent spread of the fumigant to undesirable areas. In all such cases where the adjoining building is occupied, it should be checked frequently with a suitable gas detector during fumigation to ensure the safety of the occupants. Check local regulations for specific requirements.

Doors or hatches on milling machinery should be opened prior to fumigation. These include elevator boots, conveyor lids, settling chamber doors, dust trunks, and any other openings that will allow fumigant into the equipment. Inside doors, openings to attics and crawlspaces, cabinets, lockers, and drawers should also be opened to facilitate treatment and aeration. "Dead" spouts are particularly difficult to penetrate and should be opened before the fumigation.

Set up fumigant application equipment and fans as necessary to achieve uniform fumigant concentrations and to facilitate thorough aeration after the exposure period. The choice of a fan or fans depends upon fan capability to perform the desired function without jeopardizing the success of the fumigation. Small battery operated fans may be suitable in very small situations. A fan with tubing attached may be useful for internal recirculation of the fumigant within a building or space to aid in reaching and maintaining equalized concentrations. Adequate fans should also be available to effectively aerate difficult to ventilate situations because of construction or unexpected wind direction or calm. It may be possible to use heating system fans or other installations already in a building for improved circulation or distribution of ***Meth-O-Gas® 100***, as well as aid in ventilation after the exposure period. All fans used for the fumigation should be running when fumigant is being introduced, and left running until uniform distribution has been accomplished. Fumigators should not enter a space or building under fumigation to turn fans off or on.

See appropriate table for rate of application and exposure times.

3. **Fumigating the Structure.** Inside Release. Cylinders should be placed by a team of two people and the location of each cylinder in the building should be mapped. The cylinders should be arranged so that the fumigators can walk away from the released gas as they open each subsequent cylinder. It is recommended that polyethylene sheeting or something functionally similar be used underneath cylinders and at the point of release to prevent staining or damage to floor surfaces. Narrow cylinders should be secured to prevent tipping.

   Cylinders should be placed within a room for best distribution into all areas. Cylinders should be placed in a normal upright position and the shipping caps removed. Standpipes or curved pipes directed up and away from the cylinder can be attached. Polyethylene, nylon or similar tubing, possibly divided with tees or crosses, or other equipment can also be attached to facilitate distribution of the gas within the room or space to be fumigated.

   Place warning signs or placards on all entrances to the building. Signs and placards should conform to all local, state, and federal regulations. It is best to inform police, fire and health officials that a fumigation process is about to begin. Observe the location of the nearest outside telephone for use in case of an emergency.

   Practice or review the shooting procedure so that the operation will be done efficiently and safely. Respiratory protection equipment should be checked for leaks and other problems before the "practice session". While wearing respiratory protection, quickly open and close the cylinder valves to make certain they are in working order and thus avoid delay during the actual release.

   Applicators should not be in the building longer than 30 minutes while releasing the gas. If it is impossible for one team to do it within this time period, additional experienced teams should be used. Two people should work together while the gas is being released and when entering the structure during aerating and testing.

   Fumigators should always remain in sight of each other from the time they open the first cylinder until the time they leave the building together. While the fumigant is being released, it is advisable to have additional people, with respiratory protection equipment ready, waiting outside to assist if necessary. One member of the team should record the release of the fumigant from each cylinder so that none are missed. After making sure fumigation area is vacated, immediately lock and seal the last exit. If guards are used, they should remain on duty during release, exposure, and aeration periods to prevent unauthorized entry.

4. **Fumigating the Structure.** Outside Release. Releasing the fumigant from outside the space to be fumigated is possible in some situations and can minimize applicator exposure to the fumigant. Prepare the building as outlined previously.

   Secure the ends of each "shooting" line or hose to each point where the fumigant is to be released, using evaporating pans or plastic sheeting to prevent possible damage to some surfaces. Run each line to the cylinder(s) or manifold located outside the area to be treated. Connect each line to the cylinder(s) or manifold.

   When fumigating storages of bulk grain or other bulk commodities, such as silos, grain bins, tanks, etc., the fumigator should plan sealing and fumigant distribution to effectively fumigate all the target pests contained in the sealed space. The fumigant can be applied in several locations such as the top and bottom of the storage. For bulk commodities more than 20 feet deep, a permanent or temporary fumigant recirculation system should be considered. When recirculating fumigant through a closed loop system, plan to run fans long enough to achieve at least three complete cycles.

   After making sure fumigation area is vacated, immediately lock and seal the last exit. If guards are used, they should remain on duty during release, exposure, and aeration periods to prevent unauthorized entry.

   Open the valves to release the fumigant. Respiratory equipment must be available in the event of a major leak or equipment failure.

5. **Aerating the Building.** When the exposure period is complete, aeration generally should be started by opening previously sealed doors and windows on the ground floor. Ventilators accessible from the outside should be opened at this time.

   After partial aeration, a team of at least two trained people with appropriate respiratory protection, should begin opening windows or remaining sealed openings, starting at the lower floors and working upward. Fans should be on to assist aeration. Aeration is usually complete in four hours depending upon weather conditions and cross ventilation. No one should be allowed inside the building without respiratory protection until the methyl bromide concentration is **5 ppm** or less in the worker areas.

   Contact the police, fire and health officials previously notified of the fumigation and inform them that it has been completed.

F. **Shipboard, In Transit Ship or Shiphold Fumigation.**

   IMPORTANT. Shipboard, in transit ship or shiphold fumigation is also governed by the U.S. Coast Guard Regulations. Refer to and comply with those regulations prior to fumigation.

   Prior to fumigating a vessel for in transit cargo fumigation, the master of the vessel or his representative and the fumigator must determine whether the vessel is suitably designed and configured so as to allow for safe occupancy by the ship's crew throughout the duration of the fumigation. If it is determined that the design and configuration of the vessel does not allow for safe occupancy by the ship's crew throughout the duration of the fumigation, then the vessel must not be fumigated unless all crew members are removed from the vessel. The crew members must not be allowed to reoccupy the vessel until the vessel has been properly aerated and a determination has been made by the master of the vessel and the fumigator that the vessel is safe for occupancy (**5 ppm** or below).

   The person responsible for the fumigation must notify the master of the vessel or his representative of the requirements: 1) relating to the use of respiratory protection equipment; 2) relating to the use of detection equipment; and 3) that a person qualified in the use of this equipment must accompany the vessel with cargo under fumigation. Emergency procedures, cargo ventilation, periodic monitoring and inspections, and first aid measures must be discussed with and understood by the master of the vessel or his representative.

   During fumigation, or until a manned vessel leaves port or the cargo is aerated, the person in charge of the fumigation shall ensure that a qualified person using gas detection equipment tests spaces for fumigant leakage. If leakage of the fumigant is detected, the person in charge of the fumigation shall take action to correct the leakage, or inform the master of the vessel, or his representative, of the leakage so that corrective action can be taken.

Using appropriate gas detection equipment, monitor spaces adjacent to areas containing fumigated cargo and all regularly occupied areas for fumigant leakage. If leakage above **5 ppm** is detected, the area should be evacuated of all personnel, ventilated, and action taken to correct the leakage, before allowing the area to be reoccupied. Do not enter fumigated areas except under emergency conditions. If necessary to enter a fumigated area, wear a NIOSH/MSHA approved self-contained breathing apparatus (SCBA) or combination air-supplied/SCBA respirator (personal protection equipment). Never enter fumigated area alone. At least one other person, wearing personal protection equipment, should be available to assist in case of an emergency.

If necessary to enter holds prior to discharge, test spaces directly above cargo surface for fumigant concentration, using an appropriate gas detector and while wearing personal protection equipment. Do not enter without respiratory protection, unless fumigation concentrations are at or below **5 ppm**, as indicated by a suitable detector.

If the fumigation is not completed and the vessel aerated before the manned vessel leaves port, the person in charge of the vessel shall ensure that there be on board the vessel during the voyage: 1) at least two NIOSH/MSHA approved self-contained breathing apparatus (SCBA) or combination air-supplied/SCBA respirators; 2) one gas detection device; and 3) a person qualified in their operation.

Fumigation of any ship, shiphold, or a portion of the vessel (e.g., galley) requires careful planning. All precautionary procedures as outlined previously must be followed. Aeration should be planned so that it can be safely and effectively conducted. Adequate supplemental fans to ventilate quarters, decks, bottom of shipholds, etc., should be available for use. Tubing attached to fans or used as a temporary exhaust stack for aeration should also be prepared in advance. Recirculation systems for fumigation of grain and other commodities in shipholds must be installed before loading.

The master of the vessel or his representative and the fumigator should discuss security of an unoccupied vessel under fumigation and make arrangements to prevent unauthorized boarding. If a crew member will need to board such a vessel for a necessary ship function (e.g., boiler check) the crew member must be trained in the proper use of respiratory protection equipment. The fumigator should test all passageways and areas where the crew member will be entering to determine if fumigant concentrations exceed **5 ppm** in the air. If concentrations exceed **5 ppm**, then required respiratory equipment must be worn.

See appropriate table for rates of application and exposure times.

TABLE I
APPLICATION SUMMARY FOR STORED PRODUCTS PESTS INFESTING RAW AGRICULTURAL COMMODITIES
(NOT PROCESSED FOOD)
METH-O-GAS® 100

COMMODITY	**PESTS CONTROLLED**	**TOLERANCE** (ppm)	**DOSAGE** (lb/1000 ft^3)	**EXPOSURE TIME** (HRS)
Almonds	ants, confused flour beetle, saw toothed grain beetle, dermestids, Indian meal moth, rice weevil, khapra beetle, drugstore beetle, cigarette beetle, warehouse moth, rusty grain beetle, cadelle, groundnut bruchid, pecan weevil	200	3.5	24
Brazil Nuts		200	3.5	24
Bushnuts		200	3.5	24
Butternuts		200	3.5	24
Cashews		200	3.5	24
Chestnuts		200	6	6
Chestnuts		200	3.5	24
Filberts		200	3.5	24
Hickory Nuts		200	3.5	24
Peanuts		200	3.5	24
Pecans		200	3.5	24
Pistachios		200	3.5	24
Walnuts		200	3.5	24
Apples	ants, oriental fruit moth, coddling moth, apple maggot, apple curculio, twig borer, melon fruit fly, Mediterranean fruit fly, Oriental fruit fly, cherry fruit fly, brown mite, green peach aphid, scales, thrips	5	5	2
Apricots		20	5	2
Blueberries		20	1-2	3-4
Cherries		20	5	2
Nectarines		20	5	2
Peaches		20	5	2
Pears		5	5	2
Plums		20	5	2
Quinces		5	5	2
Strawberries		60(e)	2-3	3-4
Prunes	ants, coffee bean weevil, Australian spider beetle, saw toothed and merchant grain beetles, dried fruit beetles, Indian meal moth, confused flour beetle, warehouse moth, common grain mite	20	5	2
Barley	ants, granary weevil, lesser grain borer, rusty grain beetle, angoumois grain moth, Indian meal moth, confused flour beetle, rice weevil, saw toothed grain beetle, lesser grain borer, cadelle, khapra beetle, drugstore beetle, Australian spider beetle, cigarette beetle, warehouse moth, common grain mite, flat grain beetle, Mediterranean flour moth, red flour beetle, common bean weevil, copra beetle	50	5	12
Corn		50	2	24
Oats		50	3	24
Popcorn		240	1.5	2(a)
Rice		50	6	12(b)

TABLE I (continued)

COMMODITY	PESTS CONTROLLED	TOLERANCE (ppm)	DOSAGE (lb/1000 ft^3)	EXPOSURE TIME (HRS)
Rice	ants, armyworms, cabbage looper, European corn borer,Japanese beetle, pod borers, Oriental fruit fly, Mediterranean fruit fly, corn earworm, green stink bug, sawbugs, spider mites, cabbage maggots, lygus bug, melon aphid, pickleworm, carrot rust fly, stink bug, bean leaf beetle, Mexican bean beetle, Diabrotica beetle, cucumber beetle, false chinch bug, loopers, symphylans blister beetles, onion maggot, onion thrips, mealybugs, pepper maggot, Colorado potato beetle, potato psyllid, squash bug, squash vine borer, earwigs, darkling beetle feeding insects	50	3	24
Rye		50	3	24
Rye		50	6	12(b)
Sorghum (grain)		50	4	24
Wheat		50	3	24
Copra		100	2.5	24
Beans (all)		50	3.5	24
Beets (roots)		30	3	4
Cabbage		50	4	4(d)
Cantaloupe		20	2	2
Carrots		30	4	4
Citron		30	3	2
Cucumbers		30	2.5	4
Eggplant		20	3	4
Honeydew Melons		20	2.5	2
Jerusalem Artichokes		30	3.5	4
Muskmelons		20	2.5	2
Okra		30	3.5	2(c)
Onions		20	3	6
Parsnips (roots)		30	3	4
Peas (with pods)		50	3	2
Sweet Corn		50	3	4
Peppers		30	4	2
Pimentos		30	2.5	3
Pineapples		20	2	4
Potatoes		75	3	6
Pumpkins		20	2.5	2
Radishes		30	3	4
Rutabagas		30	3	6
Squash (summer)		30	4	2

TABLE I (continued)

COMMODITY	PESTS CONTROLLED	TOLERANCE (ppm)	DOSAGE (lb/1000 ft^3)	EXPOSURE TIME (HRS)
Squash (winter)		20	4	2
Squash (zucchini)		20	2.5	3
Sugar Beets (roots)		30	3	4
Sweet Potatoes		75	3.5	4
Tomatoes		20	3	4
Turnips (roots)		30	3	4
Watermelons		20	2.5	2
Yams		30	3.5	4
Cipolini Bulbs	ants, *Exosoma lusitanica*, mites	50	4	4
Cocoa Beans	ants, cocoa moth, cigarette beetle, confused flour beetle, warehouse moth, flat grain beetle, coffee bean weevil	50 50	1.5 1-2	12(a) 16-24
Cotton Seed	ants, *Pectinophora spp.*,khapra beetle, boll weevil, saw toothed grain beetle	200	8	24(b)(c)
Garlic	ants, *Brachycera spp., dyspessa ulula,* brown wheat mite, onion maggot, onion thrips	50	3	4
Horseradish (roots)	ants, *Baris lepidi*	30	3	4
Salsify Roots	ants, armyworm, flea beetle, leafhoppers, stink bugs, tarnished plant bug	30	3	3
Hay (alfalfa)	ants, alfalfa weevil, cereal leaf beetle	50	3	24
Grapefruit[1]	ants, *Anastrepha spp., Proeulia spp., Leptoglossus spp., Megalometis spp., Naupactus spp., Listroderes spp., Conoderus spp., Brevipalpus spp.,* aphids, citrus scale, citrus mites, leaf rollers, white flies, thrips, California orangedog, mealybugs, orange tortrix	30	3	2
Grapes		20	4	2
Kumquat		30	3	2
Lemons[1]		30	3	2
Lime[1]		30	3	2
Oranges[1]		30	3	2
Tangelos[1]		30	3	2
Tangerines[1]		30	3	2
Baled Tobacco	ants, drugstore beetle, cigarette beetle, tobacco beetle, tobacco moth, *Lepidoptera, Coleoptera*		2-3 4(a)	48-72 4
Processed Tobacco (e.g., cigars)			4(a)	4
Baled Cotton	ants, pink bollworm, boll weevil, *Lepidoptera, Coleoptera*		3 4(a)	24 2
All listed commodities	rats, mice	as listed	4-5 oz.	12-18

[1] Tolerance of fruit to methyl bromide may vary with variety of fruit. Check with local authorities or Great Lakes Chemical Corporation for additional information.

(a) Vacuum chamber fumigation

(b) Khapra beetle quarantine.

(c) Pink bollworm quarantine.

(d) Must be used in accordance with the plant quarantine program of the USDA.

(e) Pre- and post-harvest.

TABLE II
APPLICATION SUMMARY FOR PROCESSED FOOD
METH-O-GAS® 100

COMMODITY	**INSECTS CONTROLLED**	**TOLERANCE** (ppm)	**DOSAGE** (lb/1000 ft^3)	**EXPOSURE TIME** (HRS)
Apples (dried)	ants, saw-toothed beetle, merchant beetle, dried fruit beetle, Indian meal moth, confused flour beetle, Australian spider beetle, cigarette beetle, warehouse moth, common grain mite, coffee bean weevil, carob moth	125	1	24
Apricots (dried)		125	1	24
Cherries (dried)		125	1	24
Dates		125	1	24
Figs (dried)		250	1	24
Peaches (dried)		125	1	24
Prunes (dried)		125	1	24
Raisins (dried)		125	1	24
Cheese (parmesan and roquefort)	ants, cheese mites, cheese skipper, cheese maggot	325	1-2	12-24
Dried Peas	granary weevil, lesser grain borer, rusty grain beetle, angoumois grain moth, Indian meal moth, confused flour beetle, rice weevil, saw toothed grain beetle, lesser grain borer, cadelle, khapra beetle, drugstore beetle, Australian spider beetle, cigarette beetle, warehouse moth, common grain mite, flat grain beetle, Mediterranean flour moth, red flour beetle, common bean weevil, copra beetle	125	4	24
Eggs (dried)	ants, larder beetle, mites	400	1-2	12-24
Ham Houses	ants, cheese skipper, larder beetle, red legged ham beetle, mites	325	1-2	12-24
Processed Foods	ants, saw-toothed beetle, flat grain beetle, flour beetle, cigarette beetle, Indian meal moth, *Lepidoptera, Coleoptera*	125	1-2	12-24
Processed Grain (a)	ants, confused flour beetle, rice weevil, granary weevil, saw toothed grain beetle, rusty grain beetle, lesser grain borer, cadelle, khapra beetle, drugstore beetle, Australian spider beetle, cigarette beetle, *Lepidoptera, Coleoptera*	125	1.5	24
Processed Grain (b)	ants, flour beetle, saw toothed grain beetle, Mediterranean flour moth, *Lepidoptera, Coleoptera*	125	1-2	12-24
Processed Grain (c)	ants, flour beetle, grain beetle, mealworms, cigarette beetle, Indian meal moth, *Lepidoptera, Coleoptera*	125	1.5	24
Spices and Herbs (dried)	ants, saw toothed beetle, flat grain beetle, cigarette beetle, trogoderma spp., Indian meal moth, dried fruit beetle, Australian spider beetle, warehouse moth, confused flour beetle, rusty grain beetle, lesser grain borer, drugstore beetle	400	3	12

TABLE II (continued)				
COMMODITY	**INSECTS CONTROLLED**	**TOLERANCE** (ppm)	**DOSAGE** (lb/1000 ft^3)	**EXPOSURE TIME** (HRS)
Animal Feed (i.e. pet food)	ants, cigarette beetle, saw toothed grain beetle, flour beetle, Indian meal moth, *Lepidoptera, Coleoptera*	400	1-2	12-24
All listed commodities	rats, mice	as listed	4-5 oz.	12-18

(a) Corn grits and cracked rice.
(b) Processed grain from equipment fumigation.
(c) Processed grain used in production of fermented beverages.

TABLE III APPLICATION SUMMARY FOR NON-FOOD PRODUCTS METH-O-GAS® 100			
MATERIALS AND PRODUCTS	**PESTS CONTROLLED**	**DOSAGE (lb/1000 ft^3)**	**EXPOSURE TIME (hrs)**
Machinery, packing & bagging material, miscellaneous non-food cargo, (e.g., ceramic, marble, brassware, handicrafts, burlap, appliances)	woodboring insects, Coleoptera, mites, spiders, snails, cockroaches, Lepidoptera, Hymenoptera	2-6	24-72
Forest and plant products (e.g., lumber, firewood, driftwood, pallets, crates, paper, cardboard, carvings, grapevine wreaths, dried plants, Spanish moss, bamboo and wicker, mulch, etc.)	pinewood nematode, woodborers, bark beetles, termites, carpenter ants, horntails, old house borer powder post beetles, Hymenoptera, Coleoptera, woodworm, wharf borer, wood wasps, mites, Lepidoptera,	3-6	16-24
Beehives and Beekeeping Equipment, Beeboards	greater wax moth, mites, insects, diseased and feral bees, *Lepidoptera*, *Coleoptera*	1.5-2	16-24