OZONE DEPLETING SUBSTANCES

Please note: This leaflet should be read in conjunction with the Fluorinated Greenhouse Gas leaflet as these gases are increasingly used as replacements to ozone depleting substances. This leaflet also incorporates the leaflet on Acceptable Alternatives to Halon Fire Extinguishants into it.

Contents

AIM

1. The aim of this leaflet is clarify MOD policy on the use of ozone depleting substances. It also outlines the latest legislative position and the substances whose use and applications are now prohibited.

SCOPE

2. This leaflet applies to all personnel who use equipment that contain ozone depleting substances, including those that use ozone depleting substances as fire extinguishants.

INTRODUCTION

What are Ozone Depleting Substances?

3. Ozone Depleting Substances (ODSs) are those substances which deplete the ozone layer and are widely used in refrigerators, air–conditioners, fire extinguishers, in dry cleaning, as solvents for cleaning, electronic equipment and as agricultural fumigants. They include:

- Halons: Halons have found widespread use as fire extinguishants. Halon 1301 is a very effective, relatively non-toxic, gaseous extinguishant, used in fixed fire protection systems to protect against most fire risks. Halon 1211 is a volatile liquid, suitable for use in portable (hand-held) extinguishers or fixed systems protecting smaller, normally unoccupied spaces. Chlorobromomethane, also known as halon 1011, is described below. Common trade names: BCF (bromochlorodifluoromethane), BTM (bromotrifluoromethane), DTE (dibromotetrafluoroethane), Freon 12B1 and Freon 13BI.

- Hydrochlorofluorocarbons (HCFCs): HCFC-22 is widely used as a refrigerant, primarily in larger air conditioning systems in buildings and shipping. Compounds include: HCFC-22, HCFC-141b, HCFC124b, Isceon 69-S and 69-L, Suva HP80 and HP81, FX 10, Suva MP39 and MP66. Common trade names include: Arcton, Forane, Genetron, Greencool, Isceon, Suva.

4. Those Ozone Depleting Substances that have now been **banned** in the EU are:

- Chlorofluorocarbons (CFCs): The use, production, import and export have now been banned in the EU. They were primarily used as refrigerants over a wide range of temperature applications and were used as solvents in both the cleaning of precision components and printed circuits and metal cleaning. Compounds include: CFC-11, CFC-12 and CFC-114.

- Carbon tetrachloride CTC): CTC was a solvent used as a cleaning agent. It's use is now banned within the EU. Trade names include: Benziform, Benzinoform, Freon 10, Halon 104,

- 1,1,1-trichloroethane (TCA): Is a solvent which is now banned in the EU. Trade names include: methyl chloroform, chloroethane, Solvent 111 and Glenkene.

- Hydrobromofluorocarbons (HBFCs): HBFCs have found minimal use.

- Chlorobromomethane (CB): CB has found use as a fire and explosion suppressant in some industrial applications, and as a fire extinguishant in aircraft before being largely superseded by the halons. Trade names include: methylene bromochoride and Halon 1011.

- Methyl Bromide (MB): MB was used as an agricultural fumigant. From the 18 March 2010 its use was prohibited. However, in an emergency where unexpected outbreaks of particular pests or diseases may occur, the Commission may, at the request of a Member State, authorise the temporary production, and use of MB providing that the requirements are in line with Directives 91/414/EEC[1] and Directive 98/8/EC[2]. Such authorisation shall only apply for 120 days and to a quantity not exceeding 20 metric tonnes. Conditions attached to this authorisation will include strict requirements to reduce emissions during use. _Methyl bromide in this instance is regulated by the Chemicals Regulation Directorate and they can be contacted via http://www.pesticides.gov.uk/corporate.asp?id=74.

5. **Any military use of CFCs, carbon tetrachloride and 1,1,1-trichloroethane in any application is prohibited.**

6. Other commercial and chemical terms for each of the substances listed above are outlined in Annex A.

MOD use (past and present) of the ozone depleting substances

7. Halons are, or have been, used by MOD in fire protection systems in:

- Naval vessel main machinery spaces, engine compartments/rooms, diesel generator spaces and electrical compartments,
- AFV crew compartments,
- Aircraft engine nacelles, cabins, cargo compartments, lavatories, and dry bays
- Buildings, in computer rooms, control and operations centres
- Airfield crash rescue vehicles

8. HCFCs are, or have been, used by MOD in:

- Naval vessel chilled water and air-conditioning systems,
- Aircraft air conditioning systems,
- Building air-conditioning systems

9. MB has been used by MOD on a few older aircraft in engine nacelle fire protection systems and as a fumigant in treatment of timber packaging for quarantine and pre-shipment applications.

POLICY AIMS

International Policy – the Vienna Convention and Montreal Protocol

10. The international policy objective, as defined in the Montreal Protocol, is to eliminate all ozone depleting substances.

- **The Vienna Convention** – Under the Convention for the Protection of the Ozone Layer, agreed in Vienna in 1985, nations agreed to “take appropriate measures to protect human health and the environment against adverse effects resulting or likely to result from human activities which modify or are likely to modify the Ozone Layer”. This Convention provided for future protocols to provide more specific

[1] EC Directive 91/414/EEC concerning the placing on the market of plant protection products.

[2] EC Directive 98/8/EC on the placing on the market of biocidal products.

controls and to encourage research and co-operation among countries and the exchange of information. It can be viewed at:

http://www.unep.org/Ozone/pdfs/viennaconvention2002.pdf

- **The Montreal Protocol** - The Montreal Protocol was agreed in 1987 and has since been amended five times in the light of developments in alternative technologies and substances and increasing scientific understanding of the status of ozone depletion and the processes involved. The Montreal Protocol has banned, or will eventually phase out, the production of all ODSs in all nations. It is implemented in the UK by means of European Union legislation. It therefore has no direct impact, in itself, on MOD but it does drive the scope and detail of the European legislation.

The full text of the Montreal Protocol can be viewed at:

http://www.unep.org/ozone/pdf/Montreal-Protocol2000.pdf

European Union Policy

11. EU Policy is to limit and where possible prohibit the use, production, import, export and placing on the market of substances that deplete the ozone layer as well as those products or equipment containing or relying on these substances, in order to protect human health and the environment.

UK Policy

12. It is the Government's policy that production, use, imports and export of ozone depleting substances in the UK is phased out in accordance with the UK's obligations under international treaties and European legislation, and to actively support international and national measures that will achieve that objective.

MOD Policy

13. It is MOD policy to eliminate all uses of ODSs as soon as technically and economically feasible; at the very latest within the time scales outlined within EC Regulation 1005/2009 (as amended by Commission Regulation (EU) 744/2010) on substances that deplete the ozone layer. With regard to the use of halons, these should be eliminated in line with the "cut off" dates and "end dates" specified within the Annex of Commission Regulation (EU) 744/2010 see Annex D for details.

14. The release of controlled substances should be minimised and any leakages of these substances into the atmosphere should be prevented.

15. In line with the MOD Climate Change Strategy alternatives to ODSs should be sought with a lower global warming potential.

16. For the purposes of this policy the following definitions apply:

"*Cut off date*" means the date after which halons must not be used for fire extinguishers or fire protection systems in new equipment and new facilities for the application concerned.

"*New equipment*" means equipment for which, by the cut off date, neither of the following events has occurred:

i. Signature of the relevant procurement or development contract;

ii. Submission of a request for type approval or type certification to the appropriate regulatory authority.

"*New facilities*" means facilities for which, by the cut off date, neither of the following events has occurred:

i. Signature of the relevant development contract;

ii. Submission of a request for planning consent to the appropriate regulatory authority.

"*End date*" means the date after which halons shall not be used for the application concerned and by which date the fire extinguishers or fire protection systems containing halons shall be decommissioned.

EU LEGISLATION

17. Manufacture, market availability and use of substances that deplete the ozone layer are controlled by Regulation EC 1005/2009. All previous Regulations on ozone depleting substances have been revoked. Regulation EC 1005/2009 was amended by Commission Regulation (EU) 744/2010, introduced on 18 August 2010. This replaced Annex V1 of Regulation EC 1005/2009 with its own Annex effectively extending some of the dates.

18. Regulation EC 1005/2009 (with the amending Commission Regulation (EU) 744/2010) principle objective is to phase out and control all further remaining uses of ODSs and their use in maintenance and servicing of equipment (given that under EC Regulation 2037/2000 the production and placing on the market of CFCs, other fully halogenated CFCs, halons, Carbon tetrachloride, 1,1,1-trichloroethane, HBFCs, bromochloroethane and methyl bromide have been phased out and the placing on the market of those substances and of products and equipment containing those substances is thus prohibited).

19. The main features of EC Regulation 1005/2009 are as follows:

- A requirement to recapture 80% of methyl bromide used for quarantine and pre-shipment applications;
- A ban on the use of methyl bromide for quarantine and pre-shipment applications from 19 Mar 2010.
- A tightening up of existing export bans for equipment not only containing but also relying on controlled substances;
- A requirement for users of controlled substances and process agents to report on use, stocks, processes and emissions;

- A ban on the production, import, placing on the market, use and export of Dibromodifluoromethane (Halon 1202)

- A reporting requirement on the production, import, placing on the market, use and export of a number of specific substances (including n-propylbromide and chloromethane);

- Labelling of controlled substances placed on the market for feedstock/process agents and laboratory uses as well as reclaimed HCFCs;

- Harmonisation of leakage checking requirements with that of the F Gas Regulation (EC 842/2006);

- Additional restrictions on the use of recycled HCFCs;

- Licensing of all imports and exports and information requirements.

20. Details of all controlled substances under the new Regulation (existing and new) can be found in Annex B.

Areas in the new Regulation of particular concern to the MOD are:

- Virgin HCFCs are prohibited and can no longer be used[3] for the maintenance or servicing of refrigeration and air conditioning equipment.

- In order to minimise the risk of illegal use of virgin HCFCs as recycled or reclaimed material; only reclaimed or recycled HCFCs from the MOD Essential Use Bank must be used in maintenance or servicing operations. To assist with this requirement DFG have issued instructions to BOC[4] that **only** recovered/recycled HCFC is issued/supplied to military users. Cylinders are now marked with an additional 'R' e.g. (R-22 R) and the colour of the cylinder has also changed.

- From the 31 December 2014. The use of recycled HCFCs for the maintenance or servicing of existing refrigeration, air-conditioning and heat pump equipment will be prohibited.

- Any MOD research site that uses controlled substances other than HCFCs for essential laboratory and analytical use must register with the European Commission for a licence to operate. Information will have to be submitted on the substances being used, the purpose, the estimated annual consumption etc.

- The use of methyl bromide for pre-shipment and quarantine purposes will be prohibited from 18 Mar 2010.

- The critical use of halon remains; however, the European Commission has now introduced legal cut off dates for new applications and end dates for existing applications (as revised by Amending Commission Regulation (EU) 744/2010) outlined in Annex D). The European Commission may however grant derogations

[3] 'Use' is defined in the legislation as utilisation of controlled substances or new substances in the production, maintenance or servicing, including refilling of products and equipment in other processes.

[4] BOC Gases manage the MOD Essential Use Bank on behalf of MOD

from end dates or cut off dates for specific cases where it can be demonstrated that no technically and economically feasible alternative is available.

- New leakage and emission control checks have been introduced alongside the requirements to maintain records on the quantity and type of controlled substances added and the quantity recovered during maintenance, servicing and final disposal of the equipment or system. More information is given is available under the Responsibilities and Management section of this leaflet.

- New controlled substances (i.e. substances that were not included in the previous Regulation EC 2037/2000) have been added to the list of controlled substances in particular n-propylbromide (1-bromopropane), bromoethane, chloromethane, dibromodifluoromethane and trifluoroiodomethane. (see Annex B for full list of these new substances).The use, production, import, placing on the market and export of these substances is also prohibited except if they are used as a feedstock or for laboratory and analytical uses.

The full text of the Regulation and the amending Regulation can be viewed at:

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009R1005:EN:NOT

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010R0744:EN:HTML

UK Legislation

21. Regulation EC 1005/2009 (together with amending Commission Regulation (EU) 744/2010) on substances that deplete the ozone layer is directly applicable in the UK having replaced and repealed Regulation EC 2037/2000. The following legislation provides further UK specific requirements for meeting the European Regulation.

22. The Environmental Protection (Controls on Ozone Depleting Substances) Regulations 2002 controls the production, marketing, use of, trade in, emission and transport of specified ozone depleting substances. It also sets out enforcement responsibilities and penalties for contravention of the Regulation. This can be viewed at:

http://www.opsi.gov.uk/si/si2002/20020528.htm

23. The applicable legislation for England, Scotland and Wales is:

- Ozone Depleting Substances (Qualifications) Regulations 2009 S.I. 216 which revokes 2006/1510 and 2008/97 and amends the qualifications needed to recover, recycle or destroy substances. These Regulations make it an offence to, or employ someone to, work with controlled substances or methyl bromide unless qualified. The regulation is available at:

http://www.opsi.gov.uk/si/si2009/uksi_20090216_en_1

24. The applicable legislation for Northern Ireland is:

Environmental Protection (Controls on Ozone Depleting Substances) Regulations (Northern Ireland) 2003 SR 97 controls the production, use, marketing, trade in and emission of listed substances that deplete the ozone layer.

http://www.opsi.gov.uk/sr/sr2003/20030097.htm

Ozone Depleting substances (Qualifications) Regulations (Northern Ireland) 2006 SR 321 specifies the minimum training and qualifications required by anyone working with ozone-depleting substances, such as refrigeration, air conditioning and fire protection equipment or systems.

http://www.opsi.gov.uk/sr/sr2006/20060321.htm?lang=_e

PROCEDURES FOR IMPLEMENTATION OF MOD POLICY

Policy Development and Implementation Management Responsibilities

25. The management focus within the MOD for all ODS issues is the Montreal Protocol Task Force (MPTF). The MPTF is responsible for supporting DBR SSD&C (Director of Business Resilience Safety Sustainable Development & Continuity) in the development of the Department's Montreal Protocol policies and providing assurance that the policies are being implemented satisfactorily. It also co-ordinates all related activities. The MPTF[5] is chaired by a senior member of the SSD&C team with a technical secretariat provided by SSD&C. Its membership comprises representatives from all areas of MOD and interfaces with the Restricted Materials Steering Group.

Responsibilities of ODS users

26. Project Team Leaders, Project Sponsors, Equipment, Property and Facilities Managers and others (including RPCs, Private Partners and other such contractors[†]) responsible for equipment or facilities which use, or might use, an ozone depleting substance in refrigeration, fire protection, or other applications – are termed the *responsible authority* – they shall ensure that:

- All uses of the substances are identified, described and reported centrally, through the MPTF, on an annual basis[6];
- A strategy exists to replace all the identified uses of the ODSs, to support them until they are replaced where this is consistent with MOD policy and permitted under the applicable legislation, and to minimise emissions of the substances to atmosphere;
- A plan exists and is regularly reviewed to implement the strategy in order to comply with the Department's ODS and fluorinated gas policies and current legislation.

[5] The MPTF is also responsible for formulating policy on the management and use of fluorinated greenhouse gases (HFCs, PFCs and SF_6).

[6] This information can be supplied on the proforma given in Annex F or be sent as a copy of the information/data which operators of equipment containing ODSs are mandated to collect, gather and make available to the competent authority and the European Commission if requested to do so.

27. RPCs and Private Partners responsible for equipment or facilities on the MOD estate must, as the responsible authority, comply with all the requirements outlined in this leaflet, including the legal requirement to report on ODS usage. Annual reports or accidental emissions should be reported to the DE regional/area manager and forwarded to SSD&C via the DE MPTF focal point.

Restrictions on new uses

28. New designs of equipment and new installations shall not use, or incorporate, any controlled ozone depleting substance.

29. The **one** exception to this rule is the critical use of halon which can be **only** be used if:

(ii) it is prior to the cut off date of the application concerned with Commission Regulation (EU) 744/2010 Annex and

(iii) it can be demonstrated that there are no feasible alternatives or technologies available.

Restrictions on existing uses

Fire Protection

30. Halons - Users shall not procure halons in support of existing equipment or facilities. Any halon which is required to support MOD Essential Use Status should be demanded from DFG_Mgr Gases and Lubricants and be supported by the MOD Essential Use Bank. Existing applications shall be converted or replaced as soon as it is technically and economically feasible to do so or at the very least in line with the timeframes specified in the legislation. All other halon systems are considered non-essential and if not already done so should be converted, replaced, or decommissioned immediately.

31. Use of chlorobromomethane is now prohibited.

Refrigeration and Air-conditioning - HCFCs

32. Contracts or specifications for construction or refurbishment of MOD buildings shall not permit the installation of HCFC refrigeration or air-conditioning equipment or HCFC-blown insulation materials, or be written in such a way as to rule out suitable alternatives[7]. The use of virgin HCFCs is prohibited for the maintenance and servicing of refrigeration and air conditioning systems so only recycled or reclaimed HCFCs are permitted. Given that the use of recycled HCFCs within these applications is being progressively phased out the responsible authority should plan for conversion or replacement of all HCFC equipment prior to Dec 2014.

[7] DE DMG07 stipulates that air conditioning is not to be used for comfort cooling for personnel unless unavoidable, good building design must take precedence.

Solvent and Cleaning Applications

33. Use of HCFCs as solvents and as cleaning agents are prohibited under the legislation.

34. There are no known uses of HBFCs in the MOD. There shall be no new uses, and no new contracts shall call for their use.

Essential Laboratory and Analytical Uses – Controlled Substances other than HCFCs

35. Controlled substances other than HCFCs may be produced, placed on the market and used for essential laboratory and analytical uses subject to licensing and registration conditions by the European Commission. Any MOD uses which fall into this category should be notified to the MPTF and CESO MOD prior to submitting any registrations to the European Commission.

Methyl bromide – Quarantine and Pre-shipment applications

36. Use of methyl bromide in quarantine and pre-shipment is prohibited from 19 March 2010.

MOD Essential Uses

37. A *MOD Essential Use* is an application assessed by the MPTF, and authorised by DBR SSDC as:

- Critical to national defence, and
- One for which no technically and economically feasible alternative can be fitted.

38. Only a limited number of applications now have *MOD Essential Use* status. These are predominantly halon systems on naval vessels, aircraft and armoured vehicles. The classification relates to each specific application of the substances and not to the entire platform or facility concerned.

39. Regulation EC 1005/2009 lists specific Critical Uses of the halons that may continue to be supported (see Annex C). The MOD will continue to define its *MOD Essential Uses* in accordance with the criteria given in paragraph 37 and will seek to ensure, through Defra, that these uses are included in the Annex of Commission Regulation (EU) 744/2010 (which replaced Annex VI of Regulation 1005/2009), for as long as is necessary (see Annex D). Please note that any application could lose its classification as a Critical Use at any time and with little notice. Conversely, the apparent inclusion of a particular application on the Regulation's Critical Use list does not necessarily imply that that application will be authorised as an *MOD Essential Use*, nor that the *MOD Essential Use* classification will continue indefinitely. All responsible authorities shall abide by the Department's policy to convert all systems wherever it is technically and economically feasible to do so and shall regularly assess all applications for the feasibility of conversion.

40. A copy of Commission Regulation (EU) 744/2010 Annex is available to view below or in Annex D.

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010R0744:EN:HTML

41. Further additions to the *MOD Essential Uses* list will only be considered by the MPTF under exceptional circumstances and according to individual merit.

42. The *MOD Essential Use* status of any equipment or facility, and the support received from the MOD Essential Use Bank, are not guaranteed for the equipment's or facility's entire planned service life. *MOD Essential Use* status will apply only for as long as conversion is not technically and economically feasible. It must not be used as a device for delaying the onset or completion of, or reducing the funding of, conversion feasibility studies, associated research and development activities, or conversion programmes.

43. As alternative materials are developed and trialled, conversion of some *MOD Essential Uses* may become feasible. It is then implicit in the internationally accepted definition of an *MOD Essential Use* that this status is no longer appropriate. However, allocation of the necessary resources and completion of the conversion programmes will inevitably take time, during which support from the MOD Essential Use Bank must continue.

44. The entire *MOD Essential Uses* list is periodically reviewed by the MPTF to take account of technical, legislative and other developments, such as availability of new alternatives, conversion or retirement of equipment and changes in force levels.

The Montreal Protocol Substances Bank

45. *MOD Essential Uses* of halons and HCFCs are supported from the Montreal Protocol Substances Bank managed by the DE&S Defence Fuels Group (DFG). *MOD Essential Users* of the substances shall ensure that all their supplies are obtained from the MOD Essential Use Bank, through the DFG point of contact (the DFG Lubricants & Gases Manager), via their respective MPTF Focal Point. Contractors who use halons or HCFCs in support of the *MOD Essential Uses* shall draw the necessary supplies from the MOD Essential Use Bank. *MOD Essential Users* shall not procure from other sources additional quantities of the substances as part of any contract except in circumstances where export restrictions prevent the shipment of MOD Essential Use Bank stocks to locations outside the boundaries of the European Union.

46. Further information on the service provided by the MOD Essential Bank is available from the MPTF's DFG member.

THE DETERMINATION OF ALTERNATIVE SUBSTANCES

- For ODS Solvents and HCFCs

47. The responsible authority should adopt the most appropriate new refrigerant or solvent which is consistent with its responsibilities, and which meets the requirements of appropriate legislation and the Government's and the MOD's safety and environmental policies including the requirements outlined in the MOD Climate Change Strategy. In particular, the user should pay attention to MOD policies on hydrofluorocarbons and other fluorinated gases as described in Leaflet 4. However, user areas may decide to adopt particular solutions for reasons of commonality and optimised logistic support. The appropriate MPTF member should therefore be consulted for advice on these matters.

- Halons

48. The selection of an alternative to the halon fire extinguishants is potentially more problematic and complex health, safety and environmental issues need to be addressed and balanced. The MPTF has established a central clearance procedure for halon alternatives in order to assist the halon user, the responsible authority must select a halon alternative only from those that have been cleared centrally by the Surgeon General and the Director of Business Resilience (DBR) and must use and install any cleared alternative in accordance with any stipulated conditions.

49. The following paragraphs below should be consulted for those planning to convert halon systems and the appropriate MPTF Member for further guidance and information on this matter.

50. A "halon alternative" is defined as any permitted form of fire protection that can be used to protect a hazardous area previously protected by halon.

51. Further supporting information on acceptable halon alternatives can be found at the following websites and should be read in conjunction with the information contained within this leaflet:

52. MOD Policy on the replacement of Halon Fire Extinguishers and the selection of alternatives is given in Annex E.

http://www.berr.gov.uk/files/file29105.pdf

http://ozone.unep.org/teap/Reports/HTOC/Technical%20Note%201%20-%20New%20Technology%20Halon%20Alternatives%20-%20Revision%203.pdf

http://www.epa.gov/spdpublc/snap/fire/lists/index.html

REPORTING REQUIREMENTS

53. In accordance with Regulation EC 1005/2009 Article 23, all users of controlled substances and most notably the operators of the equipment containing ODSs **must** take all precautionary measures practicable to prevent and minimise any leakages and emissions of controlled substances. This includes the inspection of equipment and the maintenance of records on the quantity and type of substance installed (for recycled HCFCs) or recovered during servicing and replacement/decommissioning of equipment prior to disposal. Both servicing and recovery must be carried out be a person who is appropriately qualified to do so in accordance with the Ozone Depleting Substances (Qualifications) Regulations 2009. An overview of the training provisions is below:

Column 1 **Tasks**	**Column 2** **Equipment**	**Column 3** **Minimum Qualification**
Servicing and maintenance of equipment[8].	Refrigeration, air conditioning and heat pump equipment which is stationary at all times when in operation. Commercial and domestic refrigerators and freezers which are stationary at all times when in operation. Portable refrigeration, air conditioning and heat pump equipment.	(a) City & Guilds Certificate in Handling Refrigerants Scheme 2078. (b) Construction Industry Training Board Safe Handling of Refrigerants (J01). (c) City & Guilds Level 2 Award in F Gas and ODS Regulations Scheme 2079-11: Category I or 2079-12: Category II. (d) Construction Industry Training Board Safe Handling of Refrigerants J11: Category I or J12: Category II.
Dismantling of equipment.	Refrigeration, air conditioning and heat pump equipment— (a) which is stationary at all times when in operation; and (b) which can only be dismantled at the place at which the equipment is used.	(a) City & Guilds Certificate in Handling Refrigerants Scheme 2078. (b) Construction Industry Training Board Safe Handling of Refrigerants (J01). (c) City & Guilds Level 2 Award in F Gas and ODS Regulations Scheme 2079-11: Category I, 2079-12: Category II or 2079-13: Category III. (d) Construction Industry Training Board Safe Handling of Refrigerants J11: Category I, J12: Category II or J13: Category III.

[8] This includes servicing and maintenance of halon systems

Decommissioning of equipment.	Fire protection systems and fire extinguishers.	(a) British Fire Protection Systems Association Competence Certificate Course Class I. (b) Fire Industry Competence Certificate Course Class 1.

Table 5: Minimum Qualifications

54. A table indicating the frequency and reporting requirements of leakage checks required is shown below. The Regulation also states that any detected leakage is checked within 1 month after a leak has been repaired to ensure that the repair has been effective and that any detected leakage is repaired as soon as possible and in any event within 14 days.

Mass of fluid charge contained	Frequency of leakage checking required	Records required
≤3 kg	12 mths	Yes
<6 kg (if labelled hermetically sealed)	N/A	Yes
3 kg ≤ 30 kg	Every 6 months	Yes
30 kg ≥ 300kg +	Every 3 months	Yes

Table 6: Leakage Check Requirements depending on amount of installed substance

55. Articles 26 and 27 the EC Regulation 1005/2009 requires the UK to submit information to the European Commission on the usage, quantities recycled, reclaimed, destroyed, stock holdings, the amount used in laboratory or analytical testing, and the emissions of each controlled substance and new substance listed in Annex II of the Regulation (and in Annex B to this leaflet). Additionally the MOD are also required to provide information on the quantities of halon installed, used and stored for critical users and the measures taken to reduce their emissions and an estimate of such emissions. MOD Critical Uses of Halon are shown in Annex C. Subject to paragraph 53 MPTF members, on behalf of the MOD, must therefore collect and submit data annually on <u>all</u> applications of, halons, HCFCs and other ODSs, to include:

- Quantities installed at the year-end and used during the year, by application/Critical Use category
- An estimate of the quantities emitted to atmosphere
- A narrative on measures taken or being taken to minimise emissions to atmosphere
- A narrative on progress being made in replacement or conversion programmes

56. The information that is required is detailed in Annex F, which may serve as a suitable proforma. The information shall be submitted, wherever possible in an electronic format, to the appropriate MPTF member or other MOD focal point at each significant procurement or usage event, or at an appropriate regular interval to be agreed with the MPTF member concerned.

57. Reporting returns/proformas from RPCs, Private Partners or other contractors must supply the information to their DE area/regional manager who should then forward this information to SSD&C via central collation with the DE MPTF focal point.

58. Collated returns shall be submitted by the MPTF to SSD&C for *each calendar year by the following 31 March*. This is in line with the reporting requirements stipulated by the European Commission.

59. The responsible authority shall also notify the appropriate MPTF member of all events that result in a significant accidental or avoidable loss of any ODS. All such single-event discharges greater than 25kg of any ODS must be notified by the appropriate MPTF member to DBR SSDC. The notification of the event should include a concise description of the circumstances, the outcome of the investigation and a description of measures taken to prevent a recurrence. IRIS can be used as the reporting tool.

60. The responsible authority shall ensure that:

- All practicable measures are taken to recover the substances during maintenance and decommissioning of equipment, or prior to disposal of the equipment; and

- Any events that result in a significant accidental or avoidable loss of any of the substances are investigated and appropriate measures taken to prevent a recurrence. A record should be retained of the investigation and actions taken.

61. The deliberate or negligent venting or discharge to atmosphere of any of the substances, as a means of disposal or in other avoidable circumstances, is a criminal offence.

Disposal of recovered and unwanted ODSs

62. All ODSs and halons that are recovered during maintenance procedures or from decommissioned or converted systems must be sent to the MOD Essential Use Bank. The quantities of recycled substance will be credited to the appropriate user allocation. Under no circumstances shall a contractor be allowed to take the substances, unless they are to be used by that contractor in support of other *MOD Essential Uses*, without the agreement of the MPTF.

63. Quantities of recovered CFCs, HCFCs and halons that the MPTF has determined are not required at the MOD Essential Use Bank in support of *MOD Essential Uses* will require environmentally-safe disposal. At present, the halons may have a small positive market value and so might be sold to other critical users through the government-sponsored clearing house, the Halon Users National Consortium (HUNC). However, at some time in the very near future, these substances also will likely cease to have a net monetary value. The user must then ensure that the surplus substances are disposed of in an approved manner by an authorised contractor, with due regard for the Duty of Care and Hazardous Waste Regulations. The costs of disposal shall be borne by the user area. The DFG point of contact must be informed and will be able to advise on the options available and their relative costs.

64. Quantities of recovered HCFC may be recycled for reuse, or disposed of in an approved manner. Contractors or the DFG will be able to assist. Now that virgin HCFCs are no longer permitted, those areas that still have virgin HCFCs should contact DFG immediately to arrange disposal. This will be charged to the user area.

MOD sale and export of surplus equipment that contains ODSs

65. Regulation EC 1005/2009 prohibits the export of CFCs and halons, and equipment that contains or requires their use, to countries outside the European Union, except for halons in equipment classed as a Critical Use. It is also necessary to ensure that the Bank maintains sufficient stocks to support the remaining *MOD Essential Uses*.

66. Thus surplus MOD equipment that contains, or requires the use of, any CFC must be converted prior to sale or export to any country outside the European Union.

67. Halon 1211 and 1301 in surplus Critical Use applications may be exported. This will require authorisation in advance by the European Commission.

68. Unless agreed otherwise by the MPTF, halon 1301 and 1211 in surplus applications shall be recovered and arrangements made for it to be delivered to the MOD Essential Use Bank for recycling in support of the *MOD Essential Uses*. The potential purchaser of surplus MOD Critical Use equipment must supply sufficient quantities from its own sources if it considers it necessary to refill the halon system(s) prior to export, having ensured that any necessary authorisation has been received.

69. Applications for authorisation of an export must be made to the European Commission, through Defra. SSD&C will facilitate this process and shall be consulted. The following information is required for the declaration that exports of products and equipment containing halon are for a critical use only (article 18):

- The name and address of the exporter;
- A description of the export;
- Type and nature of products and equipment;
- The total quantity of halon involved including the number of units, the description and the quantity per unit in metric kilograms;
- The country of final destination for the products and equipment;

- Whether its virgin, recycled, recovered or reclaimed;
- A declaration that the halon is to be exported for a specific Critical Use listed in Regulation 1005/2009 Annex VI; and
- Any further information deemed necessary be Defra.

70. For the time being, HCFCs in surplus equipment can continue to be exported, provided the recipient country is a signatory to the Montreal Protocol. Authorisation in advance by the European Commission will again be required.

71. The status of a country's participation in the Montreal Protocol can be obtained from the UNEP website at:

http://www.unep.org/ozone/ratif.shtml.

Further Guidance

72. Further advice and guidance on any of the management duties described in this section can be obtained from the appropriate MPTF member or the SSD&C team

ANNEX A

CONTROLLED OZONE DEPLETING SUBSTANCES AND SOME COMMON OR TRADE NAMES OF PRODUCTS THAT MAY CONTAIN THEM

Controlled Chemicals	Possible Trade- and Alternative Names
CFCs	CFC-11, CFC-12, CFC-114, CFC-115 CFC-13, CFC-111, CFC-112, CFC-211, CFC-212, CFC-213, CFC-214, CFC-215, CFC-216, CFC-217 R11, R12, R114, R115 R13, R111, R112, R211, R212, R213, R214, R215, R216, R217 R500, R502 Algofrene, Arcton, Dional, Daiflon, Flon Showa, Floron, Freon, Forane, Frigen, Flugene, Genetron, Isceon, Isotron, Klea, Suva
CFC-113	Algofrene, Arklone, CG Triflon, Daiflon, Dional, Delifrene, Dowclene, Electrosolv, Ethena, Flon Showa, Flugene, Fluorisol, Forane, Freon, Frigen, Fronsolve, Genesolv, Genetron, Isceon, Isotron, Kaltron, Racon
Halons	Halon 1211, Bromochlorodifluoromethane, BCF Halon 1301, Bromotrifluoromethane, BTM Halon 2402, Dibromotetrafluoroethane, DTE Halon 1011, Chlorobromomethane, CB, CBM, BCM, borothene
Carbon Tetrachloride	Tetrachloromethane, CCl4, Carbon Tet, CG Triflon
1, 1, 1 Trichloroethane	Aerothene, Baltane, Chlorothene, CG Triethane, Dowclene, Genklene, Methyl chloroform, Propaklone, Solvethane
HCFCs	Algofrene, Arcton, Daiflon, FE-241, Flugene, Fluoron, Fomacel, Forane,(FX10, FX20, FX55, FX56, FX57 are HCFC-22 blends), Frigc, Frigen, Genesolv, Genetron, Greencool (or GU, HCFC-22 blends), Halotron I, Isceon (69S, 69L are HCFC-22 blends), Meforex, NAF (S-III, P-III Blitze-III are HCFC blends), Solkane, Suva (MP39, MP52, MP66, HP80, HP81 are HCFC-22 blends), Vertrel HCFC-22 (R22), HCFC-123 (R123), HCFC-141b (R141b), R401A, R401B, R401C, R402A, R402B, R403A, R403B, R406A, R408A, R409A, R411B, R507, R502, R509A

Some of the trade names may be associated with products that do not contain ODSs and/or which continue in use for ozone-friendly alternatives. In many cases, the name will be accompanied by a code or number that can be used to identify the product's composition.

The table is for guidance only and is not intended to be a complete list of products that might contain ODSs. A more comprehensive list of products that contain ODSs is maintained by the United Nations Environment Programme, and can be viewed at:

HTTP://WWW.UNEPTIE.ORG/OZONACTION/LIBRARY/MMCFILES/3328-E.PDF

ANNEX B

FULL LIST OF CONTROLLED SUBSTANCES (EXISTING AND NEW) THAT ARE STATED IN ANNEX I & II OF EC REGULATION 1005/2009

A. EXISTING SUBSTANCES

Group | Substance | Ozone-depleting potential [1] |

Group I | CFCl3 | CFC-11 | Trichlorofluoromethane | 1,0 |

CF2Cl2 | CFC-12 | Dichlorodifluoromethane | 1,0 |

C2F3Cl3 | CFC-113 | Trichlorotrifluoroethane | 0,8 |

C2F4Cl2 | CFC-114 | Dichlorotetrafluoroethane | 1,0 |

C2F5Cl | CFC-115 | Chloropentafluoroethane | 0,6 |

Group II | CF3Cl | CFC-13 | Chlorotrifluoromethane | 1,0 |

C2FCl5 | CFC-111 | Pentachlorofluoroethane | 1,0 |

C2F2Cl4 | CFC-112 | Tetrachlorodifluoroethane | 1,0 |

C3FCl7 | CFC-211 | Heptachlorofluoropropane | 1,0 |

C3F2Cl6 | CFC-212 | Hexachlorodifluoropropane | 1,0 |

C3F3Cl5 | CFC-213 | Pentachlorotrifluoropropane | 1,0 |

C3F4Cl4 | CFC-214 | Tetrachlorotetrafluoropropane | 1,0 |

C3F5Cl3 | CFC-215 | Trichloropentafluoropropane | 1,0 |

C3F6Cl2 | CFC-216 | Dichlorohexafluoropropane | 1,0 |

C3F7Cl | CFC-217 | Chloroheptafluoropropane | 1,0 |

Group III | CF2BrCl | halon-1211 | Bromochlorodifluoromethane | 3,0 |

CF3Br | halon-1301 | Bromotrifluoromethane | 10,0 |

C2F4Br2 | halon-2402 | Dibromotetrafluoroethane | 6,0 |

Group IV | CCl4 | CTC | Tetrachloromethane (carbon tetrachloride) | 1,1 |

Group V | C2H3Cl3 [2] | 1,1,1-TCA | 1,1,1-Trichloroethane (methylchloroform) | 0,1 |

Group VI | CH3Br | methyl bromide | Bromomethane | 0,6 |

Group VII | CHFBr2 | HBFC-21 B2 | Dibromofluoromethane | 1,00 |

CHF2Br | HBFC-22 B1 | Bromodifluoromethane | 0,74 |

CH2FBr | HBFC-31 B1 | Bromofluoromethane | 0,73 |

C2HFBr4 | HBFC-121 B4 | Tetrabromofluoroethane | 0,8 |

C2HF2Br3 | HBFC-122 B3 | Tribromodifluoroethane | 1,8 |

C2HF3Br2 | HBFC-123 B2 | Dibromotrifluoroethane | 1,6 |

C2HF4Br | HBFC-124 B1 | Bromotetrafluoroethane | 1,2 |

C2H2FBr3 | HBFC-131 B3 | Tribromofluoroethane | 1,1 |

C2H2F2Br2 | HBFC-132 B2 | Dibromodifluoroethane | 1,5 |

C2H2F3Br | HBFC-133 B1 | Bromotrifluoroethane | 1,6 |

C2H3FBr2 | HBFC-141 B2 | Dibromofluoroethane | 1,7 |

C2H3F2Br | HBFC-142 B1 | Bromodifluoroethane | 1,1 |

C2H4FBr | HBFC-151 B1 | Bromofluoroethane | 0,1 |

C3HFBr6 | HBFC-221 B6 | Hexabromofluoropropane | 1,5 |

C3HF2Br5 | HBFC-222 B5 | Pentabromodifluoropropane | 1,9 |

C3HF3Br4 | HBFC-223 B4 | Tetrabromotrifluoropropane | 1,8 |

C3HF4Br3 | HBFC-224 B3 | Tribromotetrafluoropropane | 2,2 |

C3HF5Br2 | HBFC-225 B2 | Dibromopentafluoropropane | 2,0 |

C3HF6Br | HBFC-226 B1 | Bromohexafluoropropane | 3,3 |

C3H2FBr5 | HBFC-231 B5 | Pentabromofluoropropane | 1,9 |

C3H2F2Br4 | HBFC-232 B4 | Tetrabromodifluoropropane | 2,1 |

C3H2F3Br3 | HBFC-233 B3 | Tribromotrifluoropropane | 5,6 |

C3H2F4Br2 | HBFC-234 B2 | Dibromotetrafluoropropane | 7,5 |

C3H2F5Br | HBFC-235 B1 | Bromopentafluoropropane | 1,4 |

C3H3FBr4 | HBFC-241 B4 | Tetrabromofluoropropane | 1,9 |

C3H3F2Br3 | HBFC-242 B3 | Tribromodifluoropropane | 3,1 |

C3H3F3Br2 | HBFC-243 B2 | Dibromotrifluoropropane | 2,5 |

C3H3F4Br | HBFC-244 B1 | Bromotetrafluoropropane | 4,4 |

C3H4FBr3 | HBFC-251 B1 | Tribromofluoropropane | 0,3 |

C3H4F2Br2 | HBFC-252 B2 | Dibromodifluoropropane | 1,0 |

C3H4F3Br | HBFC-253 B1 | Bromotrifluoropropane | 0,8 |

C3H5FBr2 | HBFC-261 B2 | Dibromofluoropropane | 0,4 |

C3H5F2Br | HBFC-262 B1 | Bromodifluoropropane | 0,8 |

C3H6FBr | HBFC-271 B1 | Bromofluoropropane | 0,7 |

Group VIII | CHFCl2 | HCFC-21 [3] | Dichlorofluoromethane | 0,040 |

CHF2Cl | HCFC-22 [3] | Chlorodifluoromethane | 0,055 |

CH2FCl | HCFC-31 | Chlorofluoromethane | 0,020 |

C2HFCl4 | HCFC-121 | Tetrachlorofluoroethane | 0,040 |

C2HF2Cl3 | HCFC-122 | Trichlorodifluoroethane | 0,080 |

C2HF3Cl2 | HCFC-123 [3] | Dichlorotrifluoroethane | 0,020 |

C2HF4Cl | HCFC-124 [3] | Chlorotetrafluoroethane | 0,022 |

C2H2FCl3 | HCFC-131 | Trichlorofluoroethane | 0,050 |

C2H2F2Cl2 | HCFC-132 | Dichlorodifluoroethane | 0,050 |

C2H2F3Cl | HCFC-133 | Chlorotrifluoroethane | 0,060 |

C2H3FCl2 | HCFC-141 | Dichlorofluoroethane | 0,070 |

CH3CFCl2 | HCFC-141b [3] | 1,1-Dichloro-1-fluoroethane | 0,110 |

C2H3F2Cl | HCFC-142 | Chlorodifluoroethane | 0,070 |

CH3CF2Cl | HCFC-142b [3] | 1-Chloro-1,1-difluoroethane | 0,065 |

C2H4FCl | HCFC-151 | Chlorofluoroethane | 0,005 |

C3HFCl6 | HCFC-221 | Hexachlorofluoropropane | 0,070 |

C3HF2Cl5 | HCFC-222 | Pentachlorodifluoropropane | 0,090 |

C3HF3Cl4 | HCFC-223 | Tetrachlorotrifluoropropane | 0,080 |

C3HF4Cl3 | HCFC-224 | Trichlorotetrafluoropropane | 0,090 |

C3HF5Cl2 | HCFC-225 | Dichloropentafluoropropane | 0,070 |

CF3CF2CHCl2 | HCFC-225ca [3] | 3,3-Dichloro-1,1,1,2,2-pentafluoropropane | 0,025 |

CF2ClCF2CHClF | HCFC-225cb [3] | 1,3-Dichloro-1,1,2,2,3-pentafluoropropane | 0,033 |

C3HF6Cl | HCFC-226 | Chlorohexafluoropropane | 0,100 |

C3H2FCl5 | HCFC-231 | Pentachlorofluoropropane | 0,090 |

C3H2F2Cl4 | HCFC-232 | Tetrachlorodifluoropropane | 0,100 |

C3H2F3Cl3 | HCFC-233 | Trichlorotrifluoropropane | 0,230 |

C3H2F4Cl2 | HCFC-234 | Dichlorotetrafluoropropane | 0,280 |

C3H2F5Cl | HCFC-235 | Chloropentafluoropropane | 0,520 |

C3H3FCl4 | HCFC-241 | Tetrachlorofluoropropane | 0,090 |

C3H3F2Cl3 | HCFC-242 | Trichlorodifluoropropane | 0,130 |

C3H3F3Cl2 | HCFC-243 | Dichlorotrifluoropropane | 0,120 |

C3H3F4Cl | HCFC-244 | Chlorotetrafluoropropane | 0,140 |

C3H4FCl3 | HCFC-251 | Trichlorofluoropropane | 0,010 |

C3H4F2Cl2 | HCFC-252 | Dichlorodifluoropropane | 0,040 |

C3H4F3Cl | HCFC-253 | Chlorotrifluoropropane | 0,030 |

C3H5FCl2 | HCFC-261 | Dichlorofluoropropane | 0,020 |

$C_3H_5F_2Cl$ | HCFC-262 | Chlorodifluoropropane | 0,020 |

C_3H_6FCl | HCFC-271 | Chlorofluoropropane | 0,030 |

Group IX | CH_2BrCl | BCM | Bromochloromethane | 0,12 |

[1] The figures relating to ozone-depleting potential are estimates based on existing knowledge and will be reviewed and revised periodically in the light of decisions taken by the Parties.

[2] This formula does not refer to 1,1,2-trichloroethane.

[3] Identifies the most commercially viable substance as prescribed in the Protocol

B. NEW SUBSTANCES

Substance | Ozone-depleting potential |

CBr_2F_2 | Dibromodifluoromethane (halon-1202) | 1,25 |

Part B: Substances to be reported on under Article 27

Substance | Ozone-depleting potential [1] |

C_3H_7Br | 1-Bromopropane (n-propyl bromide) | 0,02 — 0,10 |

C_2H_5Br | Bromoethane (ethyl bromide) | 0,1 — 0,2 |

CF_3I | Trifluoroiodomethane (trifluoromethyl iodide) | 0,01 — 0,02 |

CH_3Cl | Chloromethane (methyl chloride) | 0,02 |

[1] The figures relating to ozone-depleting potential are estimates based on existing knowledge and will be reviewed and revised periodically in the light of decisions taken by the Parties.

ANNEX C

CRITICAL USES OF HALON

Critical uses of Halon[9]
Use of 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 sector, 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
Use of Halon 1211: • in military land vehicles and naval vessels for the protection of spaces occupied by personnel and engine compartments • 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

Table 1 CRITICAL USES OF HALONS

[9] Text in Regulation EC 1005/2009.

ANNEX D

"CUT OFF" DATES AND "END" DATES FOR CRITICAL USES OF HALONS AS STATED IN ANNEX VI OF REGULATION EC 1005/2009

CRITICAL USES OF HALONS					
APPLICATION				CUT-OFF DATE (31 December of the stated year)	END DATE (31 December of the stated year)
CATEGORY OF EQUIPMENT OR FACILITY	PURPOSE	TYPE OF EXTINGUISHER	TYPE OF HALON		
1. On military ground vehicles	1.1 For the protection of engine compartments	Fixed system	1301 1211 2402	**2010**	**2035**
	1.2 For the protection of crew compartments	Fixed system	1301 2402	**2011**	**2040**
	1.3 For the protection of crew compartments	Portable extinguisher	1301 1211	**2011**	**2020**
2. On military surface ships	2.1 For the protection of normally-occupied machinery spaces	Fixed system	1301 2402	**2010**	**2040**
	2.2 For the protection of normally-unoccupied engine spaces	Fixed system	1301 1211 2402	**2010**	**2035**
	2.3 For the protection of normally-unoccupied electrical compartments	Fixed system	1301 1211	**2010**	**2030**
	2.4 For the protection of command centres	Fixed system	1301	**2010**	**2030**
	2.5 For the protection of fuel pump rooms	Fixed system	1301	**2010**	**2030**
	2.6 For the protection of flammable liquid storage compartments	Fixed system	1301 1211 2402	**2010**	**2030**
	2.7 For the protection of aircraft in hangars and maintenance areas	Portable extinguisher	1301 1211	**2010**	**2016**
3. On military submarines	3.1 For the protection of machinery spaces	Fixed system	1301	**2010**	**2040**
	3.2 For the protection of command centres	Fixed system	1301	**2010**	**2040**
	3.3 For the protection of diesel generator spaces	Fixed system	1301	**2010**	**2040**
	3.4 For the protection of electrical compartments	Fixed system	1301	**2010**	**2040**
4. On aircraft	4.1 For the protection of normally-unoccupied cargo compartments	Fixed system	1301 1211 2402	**2018**	**2040**
	4.2 For the protection of cabins and crew compartments	Portable extinguisher	1211 2402	**2014**	**2025**
	4.3 For the protection of engine nacelles and auxiliary power units	Fixed system	1301 1211 2402	**2014**	**2040**
	4.4 For the inerting of fuel tanks	Fixed system	1301 2402	**2011**	**2040**
	4.5 For the protection of lavatory waste receptacles	Fixed system	1301 1211 2402	**2011**	**2020**

CRITICAL USES OF HALONS					
APPLICATION				**CUT-OFF DATE (31 December of the stated year)**	**END DATE (31 December of the stated year)**
CATEGORY OF EQUIPMENT OR FACILITY	**PURPOSE**	**TYPE OF EXTINGUISHER**	**TYPE OF HALON**		
	4.6 For the protection of dry bays	Fixed system	1301 1211 2402	**2011**	**2040**
5. In oil, gas and petrochemical s facilities	5.1 For the protection of spaces where flammable liquid or gas could be released	Fixed system	1301 2402	**2010**	**2020**
6. On commercial cargo ships	6.1 For the inerting of normally-occupied spaces where flammable liquid or gas could be released	Fixed system	1301 2402	**1994**	**2016**
7. In land-based command and communicatio ns facilities essential to national security	7.1 For the protection of normally-occupied spaces	Fixed system	1301 2402	**2010**	**2025**
	7.2 For the protection of normally-occupied spaces	Portable extinguisher	1211	**2010**	**2013**
	7.3 For the protection of normally-unoccupied spaces	Fixed system	1301 2402	**2010**	**2020**
8. At airfields and airports	8.1 For crash rescue vehicles	Portable extinguisher	1211	**2010**	**2016**
	8.2 For the protection of aircraft in hangars and maintenance areas	Portable extinguisher	1211	**2010**	**2016**
9. In nuclear power and nuclear research facilities	9.1 For the protection of spaces where necessary to minimise risk of dispersion of radioactive matter	Fixed system	1301	**2010**	**2020**
10. In the Channel Tunnel	10.1 For the protection of underground technical facilities	Fixed system	1301	**2010**	**2016**
	10.2 For the protection of power cars and shuttle wagons of Channel Tunnel trains	Fixed system	1301	**2010**	**2020**
11. Other	11.1 For initial extinguishing by fire brigades where essential to personal safety	Portable extinguisher	1211	**2010**	**2013**
	11.2 For the protection of persons by military and police personnel	Portable extinguisher	1211	**2010**	**2013**

ANNEX E

REPLACEMENT OF HALON FIRE EXTINGUISHANTS AND THE SELECTION OF ALTERNATIVES

MOD POLICY

1. All existing halon applications shall be converted to a suitable alternative or replaced either as soon as it is technically and economically feasible to do so or prior to the 'cut off' dates (for new equipment) and 'end' dates specified in the legislation.

REPLACEMENT AND USE OF ALTERNATIVES

2. The use of any alternative fire extinguishant, as with the halons themselves, presents potential risks to personnel and the environment. In many cases, an alternative extinguishant can be selected from the traditional extinguishants – water, foam, carbon dioxide or dry (chemical) powder – which are well established in MOD service. These are listed in Table 1 below. A number of other alternatives to the halon fire extinguishants are now available, though none is ideal. The potential risks need to be addressed and managed, but in some cases they may be considered unacceptable. The MPTF has established a clearance procedure to assist potential users in assessing the safety and environmental acceptability of these alternatives.

3. Under the co-ordination of the Department's MPTF the health and safety implications of halon alternatives are assessed by the Institute of Naval Medicine (INM), with clearance authorised by the Surgeon General.

4. The environmental acceptability of new extinguishants is assessed and subsequently authorised by DBR SSDC.

5. The responsible authority shall select the most appropriate solution only from those that are considered to be acceptable by the Surgeon General and DBR SSDC, and take due account of the caveats on their use that have been laid down.

6. These authorisations do not, and indeed cannot, address the fire extinguishing effectiveness, safety and fitness for purpose of the extinguishants in specific applications. Consequently, the appropriate responsible authority shall ensure that any fire suppression system utilising an acceptable extinguishant is fit for the intended purpose and is installed in accordance with the requirements outlined in other MOD policies, appropriate standards such as the Crown Fire Standards, and all statutory health, safety, fire safety and environmental legislation.

Category	Extinguishant	Trade name (Supplier)[1]	Composition	Maximum Concentration[2]	Notes
Traditional	Water	Various	H_2O	N/A	A C

	Foam	Various	Various	N/A	A B
	Dry Powder/ Chemical	Various	$NaHCO_3$ KCO_3 and others	N/A	A B C E
	Carbon Dioxide	Various	CO_2	5%	A B C E

Table 2 - Traditional Fire Extinguishants

Category	Extinguishant (UN designation)	Trade name (Supplier)[1]	Composition	Ext. Conc[2]	Max Conc[3]	Other restrictions	Notes
Water Mist	Water Mist	Various	H_2O (100%)	N/A	N/A	Water without additives. Potential use of additives requires separate authorisation	A B C
Inert Gas (IG)	Nitrogen (IG-100)	NN100 (Cerberus)	N_2 (100%)	40%	52%[4]	In normally occupied enclosures, the system shall be designed so that oxygen concentration does not fall below 10% at any time. If the final oxygen concentration is between 10 and 12%, personnel must evacuate within 1 minute. If the final oxygen concentration is greater than 12% and up to 15%, personnel must evacuate within 10 minute	A B C D E
	Argon (IG-01)	Argotec (Siemans Building Technologies)	Ar (100%)	45%	52%[4]		
	Nitrogen/Argon Blend (IG-55)	Argonite (Ginge Kerr Ltd)	N_2 (50%) Ar (50%)	37%	52%[4]		
	Nitrogen/Argon/Carbon Dioxide Blend (IG-541)	Inergen (Wormald Ansul UK Ltd)	N_2 (52%) Ar (40%) CO_2 (8%)	35%	52%[4]	As above, except that evacuation must be within 2 minutes (for 10% to 12% oxygen), or within 20 minutes (for greater than 12% oxygen up to 15% oxygen) and that final carbon dioxide concentration should be between 2.5 and 5%	
Fluoroiodo-carbon (FIC)	Iodotrifluoromethane (FIC-13I1)	Triodide (Pacific Scientific)[6]	CF_3I (100%)	3.6%	0.2%	Shall not be used in portable extinguishers except by trained and protected fire-fighting personnel. All precautionary measures practicable shall be taken to minimise emissions to atmosphere	
Fluorinated ketone (FK)	Nonafluoro-4-(trifluoromethyl)-3-pentanone (FK-5-1-2)	Novec 1230 (3M UK plc)	$CF_3CF_2C(O)$-$CF(CF_3)_2$	4.6 %	10%	All precautionary measures practicable shall be taken to minimise emissions to atmosphere	
Hydrofluoro-carbon (HFC)	Pentafluoroethane (HFC-125)	FE-25 (DuPont (UK) Ltd	CF_3CHF_2 (100%)	9.7%	7.5%	Non-HFC solutions shall be considered and utilised wherever they provide an acceptable solution. All precautionary measures practicable shall be taken to minimise emissions to atmosphere	A B C D E G
	Heptafluoropropane (HFC-227ea)	FM200 (Great Lakes Chemical (Europe) Ltd)	CF_3 $CHFCF_3$ (100%)	7.9%	9%		
	Hexafluoropropane (HFC-236fa)	FE-36 (DuPont)	$CF_3CH_2CF_3$ (100%)	7.3%	10%	Non-HFC solutions shall be considered and utilised wherever they provide an acceptable solution. Shall only be used in fixed systems when that system offers superior performance or better safety to personnel than any other option. Justify potential use to SSDC. All precautionary measures practicable shall be taken to minimise emissions to atmosphere	
	Trifluoromethane (HFC-23)	FE-13 (DuPont)	CHF_3 (100%)	15%	23%[5]	Non-HFC solutions shall also be considered and utilised wherever they provide an acceptable solution. Shall only be used when no other alternative is technically feasible or meets requirements for fire protection performance or safety to personnel. Justify potential use to CESO (MOD). All precautionary measures practicable shall be taken to minimise emissions to atmosphere	

Table 2 - Acceptable Alternatives to the Halon Fire Extinguishants

NOTES FOR TABLES 1 AND 2

N /A Not applicable

i. Other trade names and suppliers may exist.

ii. Quoted values are the minimum design concentrations of extinguishant required to put out fires. These are guidance values based upon the established cup burner test of extinguishing performance against heptane, with an added 20% safety margin. Some suppliers may consider a 30% margin to be more appropriate. The optimum concentrations for each application must be established by the appropriate responsible authority.

iii. Quoted values are the maximum system design concentrations (i.e. the final concentration of extinguishant, by volume, when evenly distributed, after a system is fully discharged) permitted by the Surgeon General, when installed in normally occupied enclosures. If higher concentrations are to be considered, appropriate procedural and engineered safeguards must be in place to ensure that unprotected personnel are not exposed. Higher concentrations can be used in normally unoccupied enclosures provided the risk assessment indicates a minimal hazard to nearby personnel, and in normally occupied enclosures for the agents listed in Table 3 where exposure duration will not exceed the limits specified for the particular agent in that Table.

iv. A design concentration of 52% for the inert gases will produce a final oxygen concentration of 10%. Ideally, design concentration should be less than this if personnel might be present. For example, a design concentration of 43% will result in a final oxygen concentration of 12%. The acceptable oxygen levels are based upon the theoretical calculation of extinguishant design concentration, and do not take account of possible oxygen consumption by any fire present in an enclosure.

v. The maximum permissible concentration of 23% is changed from that originally authorised by the Surgeon General, in the light of additional data that have been made available by the manufacturer.

vi. The listed manufacturer originally marketed the product with this trade name but may no longer do so.

A Suitable for use against Class A fires (paper, wood and other cellulose-based materials).
B Suitable for use against Class B fires (liquid fuels, lubricants and associated products).
C Suitable for use against Class C fires (hydrocarbon gases, hydrogen).
D Suitable for use against Class D Fires (ordinary metals, excluding magnesium).
E Suitable for use against electrically-induced fires.
G The extinguishant must be recovered for reuse, recycling or appropriate disposal when a system undergoes a maintenance procedure or is decommissioned at the end of its useful life. The installation of new systems and the use of HFCs to top up or refill existing systems must be reported to the appropriate HAWG or MPTF member in accordance with the reporting requirements outlined in the section on Reporting Requirements at the end of this leaflet.

Responsibilities of Halon Users

7. Project Team Leaders, Project Sponsors, Equipment, Property and Facilities Managers and others responsible for equipment or facilities in which a halon fire extinguishant is being used or replaced – the *responsible authority* – shall ensure compliance with the policy described here. The responsible authority shall also ensure compliance with the relevant policy requirements described in the Leaflet on substances that deplete the ozone layer, and the Leaflet on fluorinated greenhouse gases.

ACCEPTABLE FIRE EXTINGUISHANTS

8. The Surgeon General and DBR SSD&C consider the use of the following fire extinguishants, in addition to the traditional extinguishants, to be acceptable as halon alternatives, subject to certain caveats:

- Water mist or fine water spray (without additives);
- The inert gas extinguishants containing nitrogen, argon, or mixtures thereof, and one containing a smaller quantity of carbon dioxide;
- The halocarbon extinguishants iodotrifluoromethane (FIC-13I1); nonafluoro-4-(trifluoromethyl)-3-pentanone (FK-5-1-2); heptafluoropropane (HFC-227ea); pentafluoroethane (HFC-125); hexafluoropropane (HFC-236fa); and trifluoromethane (HFC-23).

9. Table 2 (shown earlier) gives fuller details of these extinguishants, which are intended primarily for use in fixed, total-flooding, systems. Particular attention must be paid to the health and safety and environmental caveats covering their use, which are also listed in Table 2 and Table 3.

Health and Safety Implications Relating To Fire Extinguishant Selection And Use

10. The acceptable extinguishants are considered suitable for use in enclosures requiring active fire suppression provided personnel are not at risk of exposure, without suitable protection, to concentrations in excess of limits stated in Tables 3. The extinguishants iodotrifluoromethane and pentafluoroethane have maximum exposure limits below their effective or design concentration. Consequently, they are intended only for use in normally unoccupied spaces or where suitable safeguards have been engineered to prevent discharge of a system when unprotected personnel may be present.

11. It must always be the intention for unprotected personnel to be exposed to fire extinguishants for the shortest period possible, with no exposure as the ideal. However, safe concentrations have been determined, where applicable, for each of the extinguishants. Where there is a risk of exposure, or where there may be an operational need to consider such exposure, fire protection systems can be designed in accordance with these safe limits. For some of the halocarbon extinguishants, time-dependent safe exposure limits have been determined such that systems can be specified using higher concentrations of extinguishant where a risk assessment demonstrates that, or procedures are in place to ensure that, exposures will not exceed a certain duration. These time-dependent, safe, design concentrations are listed in Table 3.

12. The installation of systems in accordance with these exposure limits does not imply that the use of the extinguishants in a fire scenario will result in an atmosphere that is safe for personnel to breathe. The clearance of the extinguishants relates specifically to the toxicity of the extinguishants themselves or, in the case of the inert gases, to the reduced level of oxygen induced by the extinguishants. The toxicity of likely halocarbon extinguishant breakdown products, in particular hydrogen fluoride (HF), and any interaction of the extinguishants with products of the fire, and any interaction of physiological changes (induced by the inert gases) cannot be assessed from a general standpoint. These factors must therefore be considered as part of the risk assessment process when the extinguishant is being selected and the system is being designed.

13. In the light of these factors, it is advised that any occupants should always evacuate a protected area as soon as an alarm is sounded, *before* an extinguishant is discharged. Any occupant caught, for whatever reason, in a discharge, should be actively discouraged from remaining in the protected area when an extinguishant is present, and should, additionally, be prevented from returning to a contaminated enclosure without suitable protection until it is safe to do so. Where operational needs may demand continued occupation of a protected space, suitable personal protective equipment must be provided.

14. The Surgeon General may consider the approval of higher maximum permitted concentrations for the acceptable extinguishants on submission of a supporting case through the appropriate MPTF Member.

Extinguishant (Trade name)	**Concentration**		**Maximum exposure duration (seconds)**	**Extinguishant (Trade name)**	**Concentration**		**Maximum exposure duration (seconds)**
	More than	**Up to**			**More than**	**Up to**	
FIC-13I1 (Triodide)	0.20%	0.30%	300	HFC-125 (FE-25)	7.5%	11.5%	300
	0.30%	0.35%	250		11.5%	12.0%	100
	0.35%	0.40%	45		12.0%	12.5%	35
	0.40%	0.45%	30		12.5%	13.5%	30
	0.45%	0.50%	20				
HFC-227ea (FM200)	9.0%	10.5%	300	HFC-236fa (FE-36)	10.0%	12.5%	300
	10.5%	11.0%	65		12.5%	13.0%	100
	11.0%	11.5%	35		13.0%	13.5%	55
	11.5%	12.0%	30		13.5%	14.0%	45
					14.0%	14.5%	35
					14.5%	15.0%	30

Table 3 - Maximum Permitted Exposure Duration for Different Concentrations of Halocarbon Fire Extinguishants

Environmental Implications of Fire Extinguishant Selection and Use

15. The environmental implications of the specification and use of any fire extinguishant or fire protection system shall be considered as part of an overall fire risk assessment process, whether this pertains to the procurement of a new facility or equipment, or the replacement of halon extinguishants. As part of the process, the responsible authority should minimise, by careful design or redesign, both the potential for, and consequences of, any fire. Where the residual risk justifies the installation and use of extinguishers or fixed fire suppression systems, all options should be considered at the outset. Where a range of options is identified which meets other requirements for performance, safety, compatibility with equipment and whole life-costs, the most environmentally friendly solution should be chosen.

16. The environmental impact of the use of traditional extinguishants will normally be minimal, However, they are not necessarily environmentally benign if used in large quantities – foams, for example, can pollute watercourses and groundwater. Careful management of their use will be required to minimise the environmental impact in such cases. Use of inert gas extinguishants will have negligible environmental impact because of their natural presence in the atmosphere. Also, use of gaseous extinguishants with short atmospheric lifetimes will not present a significant environmental threat.

17. Hydrofluorocarbon (HFC) extinguishants, on the other hand, are fluorinated greenhouse gases. Although they have zero ozone depletion potentials and so do not harm the ozone layer, when emitted to atmosphere they will contribute to changes in the global climate induced by human activities. Their relative impacts vary substantially, but they all have long atmospheric lifetimes and high global warming potentials (GWPs). Other extinguishants must be considered and selected where suitable. If an HFC is selected, all practicable precautionary measures must be taken to prevent spurious discharges, and the extinguishants are **not** to be discharged during firefighting training or routine system maintenance procedures. Discharges during system testing or certification should only be considered when they are absolutely necessary to demonstrate a satisfactory level of performance and safety and, even then, should be restricted to 'first of class or type' systems. Trifluoromethane has amongst the highest known GWPs. It should be selected only as a last resort and the selection must be justified to DBR SSDC through the chair of the MPTF. It is likely that restrictions on the longer-lived HFCs will increase in future years. The Leaflet on fluorinated greenhouse gases provides further information on the legislative and policy constraints on use of HFCs.

18. The installation of new Perfluorocarbon (PFC) extinguishants and fire protection systems are prohibited given that they are fluorinated greenhouse gases whichhave very long atmospheric lifetimes, very high GWPs and, once emitted, effectively remain in the atmosphere indefinitely. Furthermore, their properties as fire extinguishants are not significantly better than other options. For these reasons, new uses of PFC fire extinguishants are considered to be unacceptable.

19. Where several options are fit for the purpose, the above environmental factors imply that selection should be made in the order:

(1) Traditional extinguishants, water mist, the inert gases, iodotrifluoromethane and nonafluoro-4-(trifluoromethyl)-3-pentanone;

(2) Heptafluoropropane and pentafluoroethane;

(3) Hexafluoropropane;

(4) Trifluoromethane.

Unacceptable Fire Extinguishants

Unacceptable fire extinguishants are listed in Table 4 below.

Category	Extinguishant	Composition	Notes
Halon	1211 (BCF)	CF_2BrCl Bromochlorodifluoromethane	High ozone depletion potential; MP and EU production ban; procurement and use in new facilities or designs of equipment is prohibited. [Leaflet 7] describes MOD policy relating to existing uses
	1301 (BTM)	CF_3Br Bromotrifluoromethane	
	2402 (DTE)	$C_2F_4Br_2$ Dibromotetrafluoroethane	
	1011 (CB)	CH_2BrCl Chlorobromomethane	
Halocarbon	CTC	CCl_4 Carbon tetrachloride	
	MB	CH_3Br Methyl bromide	
Hydrochlorofluoro-carbon (HCFC)	NAF SIII Halotron I (Examples Only)	HCFC or blend containing HCFCs	EU legislation prohibits the use of HCFCs as fire extinguishants, with a very limited number of exceptions. Procurement and use are prohibited in new facilities or designs of equipment. [Leaflet 7] describes MOD policy relating to existing uses
Perfluorocarbon (PFC)	PFC-410	Perfluorobutane	Very high GWP and long atmospheric lifetime. Forthcoming European legislation will prohibit their use in new fire protection systems. [Leaflet 4] describes MOD policy relating to existing uses
	PFC-618	Perfluorohexane	

Table 4 - Unacceptable Fire Extinguishants

Other Fire Extinguishants

20. Other fire extinguishants that show promise or are offered by industry should not, in the first instance, be rejected as unacceptable, unless they appear in Table 4. The status of any product not mentioned in this leaflet should be clarified with the appropriate MPTF member before its use is considered.

Further Advice and Guidance

21. Appendix 1 – An introduction to some of the issues that may influence the selection of a suitable alternative fire extinguishant - provides *initial* guidance on the advantages and disadvantages of the halon alternatives and some of the factors that should be considered during the selection and risk assessment processes. Further advice and guidance may be obtained from the appropriate MPTF member, whose contact details are available from TLB Focal Points and who should be consulted at the outset.

APPENDIX 1 TO ANNEX E

AN INTRODUCTION TO SOME OF THE ISSUES THAT MAY INFLUENCE THE SELECTION OF A SUITABLE ALTERNATIVE FIRE EXTINGUISHANT

PURPOSE

1. This Appendix is intended for initial guidance only. Its aim is to provide existing halon users, and potential users of halon alternatives, with introductory information on the fire extinguishants that are currently available, and to raise some of the issues that must be addressed fully during the risk assessment by the responsible authority. In so doing, it describes the extinguishants' mode of operation, range of application, and some notable advantages and disadvantages. However, this Annex should not be considered as a comprehensive statement of all the issues that need to be addressed: the subject is a complex one, and the importance and consequences of the many factors that influence the selection of an extinguishant will depend upon the application concerned. The responsible authority should undertake appropriate consultation as necessary for fuller advice relating to the application concerned and, as outlined in the accompanying Leaflet, must ensure that, where required, an extinguishant is selected which is safe, environmentally acceptable and fit for the purpose.

THE NEED FOR ACTIVE FIRE SUPPRESSION

2. When considering the replacement of a halon system, or the installation of a new fire protection system, the responsible authority must initially assess whether an active fire suppression system is necessary. Rapid detection and careful design to maximize fire prevention or control, may provide adequate protection of personnel and equipment. If active fire suppression is determined to be necessary, the full range of options, outlined in the following paragraphs, should be considered.

TRADITIONAL EXTINGUISHANTS

Water

3. Water, in portable extinguishers or fixed water spray or sprinkler systems, extinguishes fires by heat absorption and is particularly effective against Class A (paper, wood and other solid fuel) fires. It is not suitable for use against Class B (liquid fuel) fires, or against fires involving live electrical equipment. Sprinkler systems are a well-established, reliable, technology. Relatively large quantities of water are normally used, and this can damage the protected equipment. They are, therefore, best seen as protecting a structure and its occupants rather than its contents. However, protection is normally zoned so that water is discharged only in the area of a fire. Many systems are heat activated, which can result in slow response to a fire. High sensitivity smoke detection technology may be utilised to improve this aspect.

Carbon dioxide

4. Carbon dioxide, which is suitable for use in fixed systems or portable extinguishers, works by a combination of heat absorption and oxygen dilution or blanketing. It is a clean, gaseous, extinguishant with good penetration into complex or cluttered spaces, and can be used against Class A or B fires and on live electrical equipment. It is stored as a liquid at high pressure. Portable extinguishers tend to be heavy and noisy on discharge. In fixed systems, the extinguishing concentration is lethal to any personnel in the enclosure.

5. Therefore, careful assessment of the risks involved is essential. As a minimum requirement, the system must be locked off to prevent a discharge if personnel are present in the protected enclosure. The risks to personnel who may be present in areas surrounding the protected enclosure must be considered. The quantity of extinguishant required is relatively high, and so a large storage capacity, with high-pressure pipework, is required. Such a system may not be suitable where space and weight are limited. Discharge of a carbon dioxide system may result in rapid cooling of equipment and consequential thermal shock.

Dry powder/chemical extinguishants

6. Dry powder/chemical extinguishants, available in different compositions, are effective against Class A, B and C fires. They are suitable for use in portable or fixed systems, though the latter are normally used where risks of flammable liquid fires are significant. They can be the most effective extinguishants, on a weight basis, but adequate distribution of the extinguishant may be problematic in a cluttered or obstructed enclosure. The extinguishant clean-up after discharge and the need for decontamination of equipment are often undesirable consequences of the use of a powder. Risks to any personnel exposed to the powders must be addressed: fixed systems are normally restricted to unoccupied enclosures.

Foams

7. Foams, which are available in many types and compositions, and which include high expansion and film-forming categories, need to be selected carefully to counteract the hazard that is present. All types are most effective against Class B pool fires, where they form a barrier between the fuel and oxygen from the air. They are not as effective against fuel spray or running fires, and they should not be used where water would pose a hazard to equipment or enclosure contents. Corrosion of certain metals may result from use of certain foams. Foams can be used in portable extinguishers or as additives in fixed water spray systems.

8. Some of the fluorinated components of certain foams, in particular the aqueous film forming foams (AFFF), are potentially toxic and bioaccumulative, will survive for lengthy periods in the environment, and can cause significant contamination of ground and surface waters. Use of such foams has now been prohibited under Directive 2006/122/EC relating to restrictions on the marketing and use of certain dangerous substances and preparations (perfluorooctanesulfonates (PFOS)) and the transposing UK legislation – Controls on Dangerous Substances and Preparations (Amendment) (No.2) Regulations 2007 S.I. 3438. Marketing and Use of PFOS foams is now prohibited but use of foams placed on the market before 27 Dec 2006 can be used until 27 June 2011 when the ban on the use of PFOS foams becomes universal, at this point any stocks of the substance must be sent to DFG for disposal.

9. Therefore in order to comply with the legislation, use of PFOS foams should be avoided, especially in firefighter training. Where use of substantial quantities of foams at establishments is anticipated, preventative measures must be taken to contain, recover and correctly dispose of, usage run-off and accidental spillage.

Water mist

10. This technology is also variously described as water fog or fine water spray. It works primarily by the depletion of oxygen as the water is vaporised, especially in a sealed compartment, and by the rapid absorption and dissipation of heat from the fire. The fine water mist relies on sprays of relatively small diameter droplets (less than 200µm) to extinguish fires. The small droplets ensure that the process is more effective than with conventional sprinklers or water sprays. Therefore, relatively small quantities of water are required.

11. The mist can be effective against Class A and B fires and is claimed to cause minimal damage to electrical or other equipment. It may also be suitable for use against electrically induced fires, though this will depend upon a number of factors including the maximum voltage of the fire protected equipment, whether it is isolated and earthed before the mist is discharged, the quality and rate of application of the water and the nature of the additive.

12. Water mist does not act as a gaseous extinguishant, and a system must be carefully designed to ensure that droplets with the correct properties can interact effectively with any likely fire in the enclosure. Exposure of equipment to temperatures below 0°C may also restrict its application. A water mist system that is designed to flood an enclosure will increase the turbulence in that enclosure and disturb any smoke layer. Although, the discharge may reduce visibility, its cooling effect will significantly enhance survivability in a fire inside an occupied enclosure. Water mist is mainly marketed for fixed system applications, though portable equipment is available but may not be suitable for use in confined spaces.

13. Recent advances in nozzle design and improved theoretical understanding of fire suppression processes has led to the development of a number of water suppression systems. However the performance of a particular water mist system is dependent on its ability to generate sufficiently small droplet sizes and distribute adequate quantities of water throughout the compartment. This depends on the droplet size, velocity, distribution and spray pattern geometry, as well as the momentum and mixing characteristics of the spray jet and test enclosure effects.

14. The performance of water mist systems may be improved by the use of additives .e.g. anti-freeze, foams and other additives, which may also be useful in depressing the freezing point of the water. The safety implications of the potential use of several additives will have to be assessed in advance by INM. The use of any additive in a total flooding water mist system protecting an enclosure where personnel may be present will need to be cleared in advance by the Surgeon General, in accordance with the procedures outlined in the Leaflet.

Gaseous Extinguishants

Alternative gaseous extinguishants fall into two categories:

- Inert Gases; and

- Halocarbons

Inert gases

15. The inert gas extinguishants put out fires by reducing the oxygen concentration inside an enclosure to below 15%. They are typically used at design concentrations of 35-50 vol % which reduces the ambient oxygen concentration to between 14% to 10% by volume respectively. Reduced oxygen concentration (hypoxia) is the principal human safety risk for inert gases except for carbon dioxide which has serious health effects at progressive severity as its concentration increases above 4%. With respect to inert gases, provided the oxygen concentration remains above 12%, occupants can survive without significant adverse effects, *caused by the extinguishant,* for a reasonable period.

16. A large quantity of extinguishant, stored as a gas in high-pressure cylinders, is required. This may rule out applications where space and weight are limited. For the majority of commercially available systems, existing halon system distribution pipework is unlikely to be suitable. However, at least one supplier claims recently to have developed pressure-reduction technology that enables their inert gas system to utilise existing halon pipework. Discharge, and hence fire extinguishment, is relatively slow, compared to the halon or halocarbon extinguishants. The extinguishants are effective against Class A**,** B and C fires, and on live electrical equipment, but are suitable only for fixed systems. The inert gas extinguishants are economical in use and have negligible environmental impact as they are neither ozone depleting substances nor greenhouse gases. Thus system discharge tests are acceptable and recommended.

Halocarbon extinguishants

17. Hydrofluorocarbons (HFCs) work largely by heat absorption. Because there is no chemical-catalytic interaction with flames, they are less effective than the halons they are intended to replace. Consequently, at least twice as much extinguishant is required for similar performance, and none can be truly considered as a drop-in replacement for the halons. Heptafluoropropane, hexafluoropropane and pentafluoroethane systems can utilize cylinders and distribution pipework similar to those used in halon systems, but more, and/or larger, cylinders will be needed if comparable protection is required. Trifluoromethane has a higher vapour pressure and will require a system sufficiently robust to withstand it, more akin to a carbon dioxide system than to the halons. The main disadvantage to the use of HFCs as fire extinguishants is their extremely high Global Warming Potential (GWP) as outlined in Annex B so their use to each individual applications must be considered carefully.

18. Perfluorocarbons (PFCs) have been marketed as halon alternatives. They are intrinsically less toxic than the HFCs but work in a similar manner, largely by heat absorption, and have similar performance properties. However, they have a very long atmospheric lifetime and high global warming potential, and these environmental properties mean that their use in new fire protection systems is prohibited. They can continue to be used to maintain an existing system.

19. One company markets a fluorinated ketone (nonafluoro-4-(trifluoromethyl)-3-pentanone), which extinguishes fires predominantly by heat absorption and performs similarly to many of the HFCs. Its main advantages over the HFCs are that it has a relatively large margin between extinguishing concentration and maximum safe exposure levels, and it has a relatively short atmospheric lifetime, which means that its use has a minimal environmental impact.

20. With all these halocarbon extinguishants, the process of extinguishing a fire produces highly toxic and corrosive extinguishant breakdown products, primarily hydrogen fluoride (HF). With large rapidly growing Class B fires in particular, the breakdown products may be formed in significant quantity, possibly ten times that released by a similar successful halon extinguishment. These species may add appreciably to the potentially significant danger posed to any personnel in the enclosure by the fire combustion products. The system should be designed to maximise the extinguishant concentration, within the appropriate maximum exposure constraints, and minimise discharge times. However, the relative magnitude of the hazard from extinguishant breakdown is difficult to assess because of the variable nature of the fire hazard itself. In general, the faster the extinguishant is discharged, and the higher the concentration that is achieved, the faster the fire will be extinguished and the smaller will be the potential hazard from the post-fire atmosphere. The most hazardous situation will occur if a halocarbon system *fails* to extinguish a fire. A design concentration with a sufficient safety margin should be selected to ensure that this would be an unlikely eventuality. The possible disadvantage of extinguishant decomposition should be weighed against the somewhat slower response of the inert gas extinguishants, which will allow a greater build up of toxic combustion products if a rapidly growing fire is present. The issue of extinguishant decomposition must be considered during the selection process.

Iodotrifluoromethane

21. Iodotrifluoromethane is currently the only commercially available gaseous halon alternative that extinguishes fires using a chemical-catalytic action similar to that of halons 1211 and 1301. In fact, the compound is similar to halon 1301 and differs only in the presence of iodine instead of bromine. This difference changes the chemical's atmospheric properties such that it is short-lived and has negligible ozone depletion or global warming potentials. But it ensures that it is the only comparably effective extinguishant that may be suitable for use in existing halon systems. Unfortunately, the product is relatively toxic, with a maximum exposure concentration (time-independent) of 0.2%. It is therefore suitable only for the protection of normally unoccupied spaces and measures must be taken to prevent human exposure to a discharge concentration. The extinguishant's compatibility with enclosure materials and stability if stored in high-temperature environments should also be confirmed.

Inert Gas Generators, Pyrotechnically Generated Aerosols and Hybrid Fire Extinguishing Systems

22. Technologies are becoming commercially available which utilise propellant formulations to produce and/or distribute extinguishants within an enclosure. The propellant charges can either produce large quantities of inert gases (the inert gas generators (IGGs)), or a buoyant cloud of very fine chemically-active particles (the pyrotechnically generated aerosols (PGAs)), or can be used to eject and distribute rapidly a liquid extinguishant (the hybrid fire extinguishing systems).

23. Whereas inert gas generators use a solid material which oxidises rapidly producing large quantities of CO_2 and nitrogen the Fine Solid Particulate (aerosol) systems have extinguishant properties that are achieved by combined action of two factors (i) flame cooling due to aerosol particles heating and vaporising in the flame front as well as (ii) a chemical reaction. Solid aerosols must act directly upon the flame. The gases act as a means of delivering aerosol towards the fire.

24. All these technologies benefit from ease of installation and low system weights because there is no requirement for distribution pipework or to store extinguishants under pressure. The IGGs and PGAs may prove useful in normally unoccupied spaces where weight and space are critical factors; they have found use in aircraft dry bays, for example. PGAs would need to be carefully installed to ensure adequate distribution of the aerosol in cluttered or large compartments. Exposed surfaces would be contaminated with the powder, though this would not be of the magnitude experienced with conventional dry chemical extinguishants. The hybrid fire extinguishing systems have the advantage of very rapid response times, of the order of milliseconds and upwards, which means they may prove useful in, for example, explosion suppression in military vehicle crew compartments.

25. Although fine particulate aerosols and the inert gases from generators do not have ozone depleting or global warming potentials, they may do wherever the aerosols are delivered by halocarbon gases.

26. The physiological effects include inhalation of particulate, blockage of airways, reduced visibility and the products of combustion from the aerosols such as HCl, CO and NO_x.

ENCLOSURE INTEGRITY

27. When installing any fixed gaseous extinguishant system, account should be taken of the large volume of gas that will rapidly enter the enclosure. Significant overpressure may occur. If a fire is present, this may be preceded by a brief but significant pressure reduction as the enclosure is cooled by the discharge. Any such pressure fluctuations may damage the enclosure, and loss of enclosure integrity could inhibit the effectiveness of the extinguishant. This factor must be considered and taken into account when an installation is being planned. Commercially available pressure relief vents, especially designed to overcome this potential problem, offer one possible solution.

FUTURE DEVELOPMENTS

28. No single extinguishant or fire suppression technology will be available, in the foreseeable future, to provide halon-like performance in the wide range of potential MOD applications. In finding a suitable halon alternative, each application will need to be assessed on its own merits and the best option selected from the range of extinguishants available. Because of the lack of an “ideal”, there is considerable research activity aimed at finding better halon-like extinguishants and alternative technologies. All such extinguishants of potential value to MOD will be assessed for clearance if or when they are sufficiently developed and become commercially available.

ANNEX F

OZONE DEPLETING SUBSTANCES AND FLUORINATED GREENHOUSE GASES REPORTING PROFORMA

1. The proforma is available as an Excel spreadsheet by following this link

ASSURANCE QUESTIONS

The purpose of these question sets is not for delivery bodies to provide answers to each question. However, they should be useful for the delivery body in stating their assurance level. If full assurance cannot be given, a short explanation of the problem area/s and the actions which are being taken to improve the assurance level is required.

Questions

1. How are accidental emissions of ODSs mitigated, prevented and reported?

2. How are the reporting requirements managed?

3. What is the standard of measurement for the emissions of ODSs across the TLB/TFA and how is this standard being improved?

4. How many sites during the last annual reporting audit period received either no assurance or limited assurance? How is this being remediated?

5. How are authorities responsible for the replacement of ODSs:
   - ensuring the new designs or installations do not incorporate or use any controlled ODSs;
   - minimise emissions of ODSs from current uses;
   - find alternatives to ODSs;
   - ensure that ODSs are eliminated fro use as soon as is feasible?

6. How many sites during the last annual reporting audit period received either no assurance or limited assurance? How is this being remediated?

7. On the basis of your responses to the questions, and the guidance that is provided in JSP 418, what level of assurance do you believe applies for your compliance with this policy area?

DIA Assurance Classifications

- **Full assurance** - The frameworks of governance, risk management and control should ensure effective, efficient and economic achievement of the business objective. Risks that threaten the achievement of that objective are adequately managed.

- **Substantial Assurance** - Weaknesses identified in governance, risk management or control frameworks. Achievement of the business objective is threatened by inadequate management of medium or low category risks.

- **Limited Assurance** - Weaknesses identified in governance, risk management or control frameworks. Achievement of the business objective is threatened by inadequate management of high category risks.

- **No Assurance** - The frameworks of governance, risk management and control do not support effective, efficient and economic achievement of the business objective