

REPLACEMENT OF HALON FIRE EXTINGUISHANTS — THE POTENTIAL FOR CONFLICT BETWEEN ENVIRONMENT AND SAFETY*

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INTRODUCTION

New European Union legislation on ozone-depleting substances is expected to become law throughout the 15 member states this year. This paper describes the principal controls on the continued use of the halons in the proposed legislation, which will likely ban the use of the halons from the end of 2002. The implications for European halon users will be significant, and a number of those implications for the UK Ministry of Defence are described. Since the UK's front-line defence capability depends upon effective fire protection—in the longer term for ships and aircraft and in the shorter term for vehicles, halons remain necessary, the implications of any halon use controls *are* potentially significant. The paper then discusses some of the possible safety issues raised by the prospect of mandated conversion of halon systems in any applications that are not exempted from the use ban. The paper raises concerns that the prescriptive nature of this environmental legislation is also potentially at odds with the MOD's risk-based technical feasibility approach to halon replacement. This activity will be increasingly managed within the framework of the MOD-wide environmental management system now being adopted. The need to balance safety and environmental protection is all the more apparent in the context of the trend towards harmonised environmental and safety management systems, and the freedom for halon users to address any such conflicts must not be compromised.

The paper expresses the personal opinions of the authors and as such is not an official statement of position of the UK Government or the Ministry of Defence on any of the issues discussed.

LEGISLATIVE AND POLICY BACKGROUND

The Montreal Protocol has banned the production of halons in the developed world. Critical Users, such as the military organisations, have, or certainly should have, made arrangements to ensure that they have access to sufficient quantities to allow them to support those uses until they are converted or retired from service. The Protocol itself does not control use of the halons, just the production. Under that agreement, and provided users have access to sufficient quantities, halon use can continue indefinitely. Whether through the policies implemented by large organisations, or through the free market laws of supply and demand, there is likely to be a shift of halon from non-critical to Critical Uses, and there is evidence that this is happening gradually.

For the governments of a number of countries (e.g., Australia and several countries in Europe), this gradual transition is not happening quickly enough. They consider it to be desirable to speed up the removal of the halons from the non-critical uses with additional legislation that controls the continued use of the halons. Those countries in Europe that have succeeded in implementing their own use controls have been pushing for their adoption in all Member States of the European Union. The argument for pan-European environmental legislation is a convincing one, since the

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environmental impact of a nation's activities is rarely confined within its own borders. Now, most environmental legislation in the UK, and in other European countries, is driven, formulated and negotiated at the European level, though individual countries within the Union are able to adopt higher environmental standards provided they are not seen as constraints on fair trade. The UK's legislation on ozone-depleting substances is no exception.

LEGISLATIVE DEVELOPMENTS IN THE EUROPEAN UNION

Within the Member States of the European Union, the Montreal Protocol is implemented by means of a European Council Regulation on substances that deplete the ozone layer. The current Regulation, known as EC 3093/94, banned the production of the halons one year earlier than the Montreal Protocol. but imposes no additional use constraints. It does, however, control the use of HCFCs, and bans their use as fire extinguishants. Because of the latest amendments to the Montreal Protocol, it is necessary for the European Union to change its legal framework on the controlled substances and introduce a new Regulation.

The process leading to the new legislation has been a lengthy one. The European Commission completed its drafting of the initial document in 1998. It was apparent from the initial draft that the technical difficulties in replacing the halons in some applications had not been fully appreciated. During negotiations between representatives of each country's environment ministries, the UK government, with assistance from the fire protection industry and major users, including the Ministry of Defence, tried with some success to ensure that the legislation took account of what was achievable. A compromise proposal was adopted in February 1999 by the Environment Council, which is made up of the elected environment ministers of each member state. The proposal was then submitted to the European Parliament for its approval. A number of changes were sought, although only one minor amendment related specifically to the halons. The proposal is now back with the Environment Council and further negotiations are taking place to produce a compromise document that all parties can accept.

Although the final form of the Regulation is yet to be agreed, significant changes are not thought to be likely at this stage. There are very few differences of opinion among the European Commission, the Environment Council of Ministers, and the European Parliament. Agreement will most probably be reached by June, though the date at which the legislation will come into effect is one factor that is yet to be agreed.

PROPOSED EUROPEAN CONTROLS ON USE OF HALONS

The main requirement of the proposed new legislation will likely be a ban on the use of halons in refilling or topping up of extinguishers and fire protection systems from the end of 2002 and the compulsory decommissioning of all halon systems from the end of 2003. There will be a list of Critical Use exemptions in the Regulation's Annex VII. This will be reviewed annually by a Management Committee made up of the European Commission and representatives from each country's environment ministry. Presumably, the intention of this committee will be to reduce the number of exemptions as quickly as possible. Each country must also report annually the quantities of halons that have been used and emitted in support of its Critical Uses, the measures that have been taken to reduce emissions from the applications, and the efforts that have been made to identify and use adequate alternatives.

Under other requirements, the export of halons from Europe will be permitted only in products or equipment intended specifically for the Critical Uses in the Annex VII. Imports will be subject to authorisation and licensing also. Users must recover halon from decommissioned systems, or during system servicing and maintenance, for destruction or recycling. All precautionary measures practicable must be taken to prevent and minimise leakages, and each country must ensure that all those who deal with halons are suitably qualified.

The proposal is likely to replace the current outright ban on HCFC extinguishants with limited permission for their use, but only in replacing the halons in the listed Critical Uses. The recovered halons must be destroyed, and the permission is subject to the HCFC supplier meeting most of the destruction costs.

CRITICAL USES OF HALONS IN EUROPE: ANNEX VII

The Annex VII of Critical Uses, as it currently stands, reflects somewhat the push and shove of different interests and concerns during the negotiation of the Regulation. Further clarification of what exactly is exempted from the **use** ban is likely at some stage, most probably after the Regulation is adopted. Some categories **are** clear; others are somewhat vague. But there is little doubt that if the issue of whether an application is or is not on the list is debated, the European Commission and the Management Committee will interpret the Regulation “tightly.” *It* can be argued that some Critical Uses have been left off all together, and a few examples are suggested below.

Annex VII, in its latest form, lists the following Critical Uses:

Use of Halon 1301:

- *in aircraft for protection of crew compartments, engine nacelles, cargo bays, and dry hays*
- *in military land vehicles and naval vessels for the protection of spaces occupied by personnel and engine compartments*
- *for the making inert of occupied spaces where flammable liquid and/or gas release could occur in the military and oil, gas and petrochemical sectors and in existing cargo ships*
- *for the making inert of manned communication and command centres of the armed forces or otherwise essential for national security existing at [date]*
- *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 hand-held fire extinguishers and fixed extinguisher equipment for engines for use on hoard aircraft*
- *in aircraft for protection of crew compartments, engine nacelles, cargo bays, and dry hays*
- *in fire extinguishers essential to personal safety for initial extinguishing by fire brigades*
- *in military and police fire extinguishers for use on persons*

As the Annex stands at the moment, some of the terminology is not strictly correct. The use of the term “making inert” does not really apply to the applications concerned since they are normally fire extinguishing applications. Other categories are broader or more vague than they perhaps need to be. The inclusion of any application “otherwise essential for national security

...” would seem to let any military organisation off the hook. depending on how loosely that organisation defined the term “essential.” And there is some duplication.

These points aside, Annex VII probably represents a reasonable first attempt at creating a Critical Use list. However, there are a number of disadvantages to any list of Critical Uses. and the idea has always been opposed by the UN Halons Technical Options Committee in its advice to the Parties to the Montreal Protocol. A list is relatively inflexible and cannot take account of the differences between different types of naval vessel, military vehicle, or aircraft applications, for example. It may be feasible to convert some equipment types or halon applications, but not others. In the proposed Regulation, there is no obvious means for recognition that, where conversion is feasible, programmes may take a long time to complete. A list may discourage research effort or conversion programmes for the exempted applications. The annual review process will be very important in overcoming these disadvantages, but will only be effective if applied carefully and rigorously.

MOD POLICY ON CONTINUED USE AND REPLACEMENT OF THE HALONS

The Regulation is certainly concentrating the minds of halon users in the UK. For a number of years. the Ministry of Defence has worked steadily towards the implementation of its policy that all halon systems should be converted to suitable alternatives wherever it is technically and economically feasible. The Ministry of Defence established the Montreal Protocol Task Force to oversee the implementation. It is chaired by the Chief Environment and Safety Officer, and has representatives and technical experts from all parts of the Department and the Royal Navy, Army, and Royal Air Force.

The Task Force has assessed all uses, and applied criteria (based upon Decision IV/21 of the Montreal Protocol) to establish *MOD Essential Uses* that are:

- (a) critical to national defence, and
- (b) for which no technically and economically feasible alternative can be fitted

The *MOD Essential Uses* are supported by a Bank of recycled and recovered material until they can be converted, or until they are retired from service. Non-essential applications must be decommissioned or converted. They are not supported by the Bank and policy prohibits users from purchasing additional quantities of the halons. The list of *MOD Essential Uses* is reviewed periodically by the Task Force. The latest review is nearing completion, and all halon uses are being reassessed in the context of the proposed legislation.

IMPLICATIONS OF THE PROPOSED HALON USE CONTROLS FOR MOD

The Regulation will have its most significant effect on the use of Halon 1301 in buildings on the defence estate. A significant number of these, mostly classed as non-essential, have been decommissioned or converted to inert gas or halocarbon alternatives. But some building *MOD Essential Uses* remain, particularly the larger systems charged with several tonnes of halon. which are the most potentially expensive and technically difficult to replace. There may be problems with finding sufficient storage space for alternative extinguishants in these applications, or with changing distribution pipework without unacceptable disruption to the operation of the facility. However, at this time, it is the intention that all remaining building systems will be

converted by the end of 2002. This deadline should be achievable, although some planned conversion schedules will have to be brought forward.

Most of the *MOD Essential Uses* of Halon 1301 in frontline equipment **are** listed as Critical Uses in the Regulation. However, there are a number of applications not in the Annex at the moment but which it will not be feasible for the UK to convert by the end of 2002. The MOD is somewhat unusual in traditionally using Halon 1211 in fixed systems to protect small, normally unoccupied, spaces. This is especially, but not only, true of older systems. Thus the engine compartments of the majority of UK armoured vehicles and the engine nacelles of its aircraft are protected by Halon 1211 systems. Many of the engine compartments of smaller naval vessels such as minesweepers, and the enclosures for naval diesel engines or turbines, are also protected by Halon 1211 systems. With the exception of the aircraft applications, these systems are not listed in the Regulation's Annex as Halon 1211 Critical Uses. The same applications *are* listed, however, as Critical Uses of Halon 1301.

The armoured vehicle engine compartment application will be converted to a suitable alternative. Whether the solution will be one of the gaseous hydrofluorocarbons or a dry chemical powder depends upon the type of vehicle. However, the logistical difficulties of doing the work are substantial, with thousands of vehicles located all around the world, and each likely taking a week or so at a base camp to convert. The programme is starting, but it will probably take five years to complete. It will not be possible to complete all conversions in **less** time than this. Operational capability must not be compromised by the removal of equipment from service to allow conversion work to be undertaken and, additionally, there is limited capacity for the Ministry of Defence or its contractors to do the work any more quickly.

Another example of an application the Ministry of Defence considers to be a Critical Use, but which is not listed in Annex VII, is the use of portable Halon 1211 extinguishers in the crew compartments of armoured fighting vehicles. Portable Halon 1211 extinguishers on aircraft are accepted as Critical Uses, and many of the hazards facing an AFV crew are similar: namely, hidden electrical or flammable fuel fires. Whilst in peacetime, the crew could perhaps bale out of the vehicle to use a dry chemical extinguisher, on a battlefield or on a peacekeeping mission where hostile opponents may surround or be attacking the vehicle, evacuation would not be an option. From the point of view of maximising the operational capability and safety of the vehicle and its crew, and not just its peacetime safety, no current portable alternative can provide an equivalent level of performance. For all the gaseous alternatives, a major constraint is the very limited space for additional or larger extinguisher bottles in the vehicle's cramped and congested crew compartment. The MOD therefore considers this application to be a Critical Use.

These examples indicate some of the issues that must be resolved with the Regulation's list of Critical Use applications as it now stands. Problems may be apparent also in other countries *or*, indeed, organisations.

Since it is considered infeasible to convert all of the remaining front-line vehicle and naval Halon 1211 systems by the end of 2002, as would be required by the Regulation as it currently stands, options for the way ahead must be considered. There are really only three routes available, and only one seems sensible. The Ministry of Defence could argue for slight changes to Annex VII to ensure that, where now classed in the Regulation as Critical Uses of Halon 1301, its equivalent Halon 1211 applications are added also as Critical Uses. In some cases, this would need only to

be temporarily, until conversion can be completed. The second option would be to convert the Halon 1211 systems to Halon 1301. This like-for-like replacement would be relatively simple and quick to do, but there would be adverse consequences both for the environment, because the ODP of Halon 1301 is two or three times larger, and for the users and their budgets. Also, Halon 1301 is in shorter supply. It is difficult to believe that the legislators who negotiated the Regulation had this intention. The final option, which would be for the MOD to be in breach of the legislation, would be politically unacceptable. We must hope that an MOD case for a change to Annex VII is viewed favourably.

SAFETY ISSUES RELATING TO CONVERSION OF HALON SYSTEMS

The example of the possible requirement to replace portable Halon 1211 extinguishers with a less effective alternative in the armoured vehicle application brings to the forefront a potential conflict of interest. Safety legislation and policy require the assessment and minimisation of the risks resulting from any changes to a vehicle. Currently, the risks are managed by retaining one or two Halon 1211 extinguishers in the vehicle crew compartments. Unless a Critical Use exemption is granted at a future review of Annex VII, the proposed new Regulation would mandate the removal of these extinguishers even though they may be argued necessary for safety reasons. There may, in some vehicles, be an increased risk to the crew. This need not be the case for all vehicle types, so each must be assessed to *see* if an alternative extinguisher can provide an acceptable level of fire protection.

Where a vehicle's engine compartment system is being converted to a hydrofluorocarbon alternative, there is limited opportunity to redesign the distribution pipework. More extinguishants might be needed to ensure effective performance. In most vehicles, there is no space available to store an increased quantity, so it may be necessary to replace the one-bottle/two-shot system with a two-bottle/one-shot system. The risks may then be increased. There is less of a potential problem with new vehicles, where alternative fire protection systems can be designed to optimise the performance of the dry chemical or halocarbon extinguishants.

In new UK warships, the normally occupied machinery spaces are, in the short term, being protected by a combination of carbon dioxide total-flooding systems, foam systems, and trained firefighting teams. Although extensive safeguards can be designed and built into new ships to minimise the potential for accidental discharges when personnel are present in the protected enclosure, there is inevitably an additional risk involved. A ship's captain may be faced with a decision to discharge a carbon dioxide system to save the ship, or wait a little longer to evacuate injured or trapped personnel. Ultimately the priority is to do the best to save the ship, its mission and the rest of the crew. With a halon system, there would at least be a good chance that any trapped personnel would survive the discharge. The risks with carbon dioxide, or indeed halocarbon, systems are potentially higher and must be managed carefully.

How any increased risks are best managed depends upon the individual circumstances and range of alternative options for each vehicle or vessel type. The flexible criteria of the *MOD Essential Use* classification allows a particular vehicle type or class of ship to retain its halon system where safety or operational capability would be unacceptably compromised by the use of an alternative. If, in practice, the new European Regulation is not sufficiently flexible to allow such differentiation and so mandates removal of halon systems, the risks to certain personnel in certain military systems and situations may be increased.

Fortunately, the Regulation's Critical Uses will be reviewed annually. It remains the intention of the Ministry of Defence to apply its criteria for *MOD Essential Uses* individually to all its uses of halons and not create a "simple" fixed list of applications that qualify. Having assessed all its applications for the feasibility of conversion, it will wish then to argue for changes to Annex VII where it believes halons cannot be replaced without an unacceptable increase in risk to personnel or an unacceptable reduction in defence capability. Any support from other European defence ministries would be welcomed.

MANAGEMENT OF HALON REPLACEMENT AND THE SAFETY OF ALTERNATIVE SOLUTIONS

The Ministry of Defence's halon replacement activities will increasingly become a formal part of its department-wide Environmental Management System (EMS). This is based upon the ISO 14001 international standard, and the framework has recently been agreed across all the Services and other parts of the MOD. A target has been set for the implementation of the EMS at all sites by April 2001. However, several establishments have already implemented, independently, EMSs on their own sites and received external accreditation. Although external accreditation is not a compulsory feature of the MOD EMS, it is encouraged where there are good business reasons for doing so. Under the EMS, performance in implementing environmental policies is monitored and reviewed, against clear targets for improvement. The EMS should help to ensure that conversion programmes for all remaining Estate uses of the halons, and other ozone-depleting substances, are on track for completion within the legislated timescales. It should also encourage the regular assessment of the feasibility of conversion of all other uses.

The need to balance safety and environment is all the more apparent with the widely supported drive towards the harmonisation of the Ministry of Defence's policies and approach towards environmental protection, health and safety, and fire safety (SHEF), because of the commonality involved in the three areas. The central policy directorates have already merged to form a single entity, headed by the MOD's Chief Environment and Safety Officer. This will support a unified Safety and Environment policy board structure, which is now being finalised. There will soon be a single SHEF policy statement signed by the Secretary of State for Defence. The unified approach is also being reflected in other front-line and support organisations throughout the MOD. A unified SHEF management system, based upon or at least compatible with the EMS, is the ultimate goal.

The management systems, whether environment or safety or unified, are all risk-based. Efforts and resources are targeted towards reducing or eliminating the risks in order of significance, and ensuring legislative compliance. The SHEF approach brings together Safety, Environment, and Fire issues with the aim of allowing a balanced assessment of costs and benefits. Tests of "reasonability" and "practicability" are common to the various disciplines and should provide a standard context for decision making. Reasonability introduces economic arguments associated with a course of action, whereas practicability without the reasonability caveat just focuses on a technical feasibility test.

The elimination of halons, as already described, highlights the way the prescriptive tendency in environmental legislation, such as the new Regulation on ozone-depleting substances, does not specifically reflect the need for the risk-based approach in modern management systems. The quantities of halons that are now installed and used in UK military equipment are relatively small

and are in the applications that are the most difficult to convert. Thus, the environmental benefit of replacing those applications is relatively small. Yet the risks, to both safety and defence capability, are potentially significant. The Regulation may divert effort from other activities or situations that carry a much more significant risk of environmental harm but which also need to be addressed.

CONCLUSION

The new European Union legislation will strictly limit the continued use of the halons. This could have a significant impact on the UK Ministry of Defence. The quantities now installed in UK military applications, and the associated usage and emissions rates, are relatively small. Thus the environmental benefit of replacing those applications is also small. Yet they are now used in the applications that are the most difficult to convert or replace and largely in front-line equipment that cannot operate without effective fire protection. In the long term for existing ships and aircraft and in the short term for existing vehicles, the halons remain necessary. The Ministry of Defence has attempted to manage this issue by participating in the negotiation of the legislation to ensure that it is flexible enough for it to be implemented without compromising safety or defence capability, or entailing excessive costs. It is also putting in place an environmental management system (EMS) to ensure that the legislation and halon replacement programmes are implemented wherever possible, taking into account an appropriate balance between maintaining operational capability and ensuring environmental protection and the safety of personnel. There will hopefully be sufficient flexibility in the proposed legislation's process for an annual review of the halon Critical Use exemptions to ensure that this balance is maintained within the framework of legislative compliance.