HALON REPLACEMENT: POLICY AND PROGRESS IN THE UK MINISTRY OF DEFENCE.

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ABSTRACT

The UK Ministry of Defence is committed to reducing its dependence on all substances regulated by the Montreal Protocol. The Montreal Protocol Task Force, chaired and supported by the Department's central environmental policy group, is coordinating all related activities. All uses of halons have been categorised as "essential" or "non-essential" to MOD operations. The former will be supported by recycling of the Department's stocks of halon until the equipment can be converted to a suitable alternative; the latter will not be supported and conversion programmes have been instituted, with users able to choose from the traditional extinguishants – water, dry powder, carbon dioxide and foam.

The Task Force established the Halon Alternatives Working Group to evaluate the new alternatives being marketed by industry. The potential safety hazards to personnel, the implications of environmental legislation and the multitude of alternatives available on the market, amongst other factors, have required the establishment of a central MOD clearance procedure, which will be described. Service users will be free to select agents from those that have been cleared, though it is obviously desirable, for logistical reasons, to minimise the number that are eventually introduced. The Working Group coordinates the clearance procedure and provides advice and guidance to users on which agents are most suitable for meeting their fire protection needs.

However, ultimate responsibility for agent selection will often lie with the user. To this end, several members of the Working Group have commissioned trials of selected alternatives. The trials, their progress to date, and the conclusions reached, are outlined.

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The UK Ministry of Defence must ensure that it complies with all national, European and international legislation on environmental protection. The MOD has an environmental policy group in central London, under the Assistant Under-Secretary of State for Infrastructure and Logistics - AUS(IL) which coordinates the Department's response to environmental legislation and ensures that its position is represented in negotiations. More proactively, the group attempts to minimise the Department's exposure to future legislative developments by ensuring that environmentally favourable options are selected wherever possible.

The Environment Group, currently known as IL(Log), chairs and staffs the Montreal Protocol Task Force (MPTF) which was established to coordinate all MOD activities in response to that specific legislation. With members from all branches of the Department, (including Army, Royal Navy, Royal Air Force, Procurement Executive, Defence Research Agency and MOD fire Service), the Task Force formulates policy for ministerial approval, coordinates all activities and provides a forum for information exchange. The members of the Task Force are responsible for dissemination of Montreal Protocol policy and for ensuring that actions are carried out successfully.

A primary concern of the MOD is to reduce its dependency on ozone depleting substances regulated by the Montreal Protocol. Users of halon and CFCs are therefore banned from purchasing further supplies of material to support existing systems. Wherever feasible, equipment must be converted to an alternative. Furthermore, new designs of equipment must not use or incorporate any ozone depleting substance.

This approach requires that equipment is supported from existing stocks of material until conversion to environmentally acceptable alternatives can be accomplished. For some applications, this may not be achieved during the lifetime of the equipment, anything up to 25 years.

To control the stocks of materials, and to ensure that they are used only where absolutely necessary, the Task Force agreed, in 1992, a list of MOD Essential Uses of halon and CFCs.

The Essential Uses of halon are defined as:

Those in equipment or facilities which are critical to the nation's defence, and for which the halon is essential to protect the effectiveness of the equipment and the safety of the personnel who use it; and

For which no alternative fire extinguishant is feasible.

The **MOD** stocks of halon will be used only in support of the Essential Uses, for the life of the equipment, or until an alternative can be fitted. All other uses of halon, being Non-essential, are to be converted to an alternative extinguishant as soon as possible. Halon recovered as a result will be used to support the Essential Uses.

Because of the absence of a suitable halon-like alternative with equivalent properties and effectiveness, most fixed halon systems in front-line equipment have been listed as Essential Uses. These include systems in ships, aircraft and armoured fighting vehicles (AFVs). Enormous numbers of halon 1211 portable or hand-held extinguishers in Headquarters buildings, other establishments, and on ships, front-line and support vehicles, were deemed to be non-essential.

In 1992, an appraisal of the options available to support the Essential Uses, minimise unnecessary losses of material, and to ensure that only eligible users received supplies, led to the conclusion that a centralised Bank should be established. This has now been commissioned. It will receive or recover all available halon, recycle it to an agreed standard, store it until required, and distribute it to the MOD's Essential Users. An on-site laboratory is available for quality control. Each branch of the Department (for example, each Service) has an allocation of material, based on anticipated usage, and is responsible for control of demands by users against that allocation. The Bank will supply regular "Bank Statements" to ensure visibility of the consumption rate. All significant discharges of halon (in other words, all except those of small hand-held extinguishers) are notified centrally. The circumstances are investigated, with the aim of reducing future similar incidences.

It was intended that the Bank should recycle halons 1211 and **1301** to ISO 7201, the standard normally required for production of new material. However, initial analyses indicated that some of the MOD's stocks of halon 1211 were outside this specification, particularly for purity and non-volatile residue. The Bank recyclers, in common, apparently, with most commercially available equipment, are unlikely to be able, consistently, to remove high levels of non-volatile residue, or to increase the purity of the material. A slight

relaxation of the standard for halon **1211** is therefore being considered for material issued by the Bank.

Non-essential Users of halon are faced with the need to replace their halon fire protection systems with an alternative as soon as possible. No supplies will be available for recharging the system after discharge, deliberate or accidental, or during maintenance top-up. Many users are resorting to the traditional extinguishants: water, dry chemical, foam or carbon dioxide. Others are reconsidering the need for a halon-like fixed system, and choosing not to replace it once it has been discharged. Adequate protection of enclosures which are normally manned can sometimes be provided by a range of hand-held extinguishers containing the traditional agents.

All the portable or hand-held halon **1211** extinguishers in HQ buildings, support vehicles, ships and on armoured fighting vehicle exteriors are being replaced with a mixture of carbon dioxide, foam and dry chemical extinguishers. Certain halon **1301** and **1211** fixed systems are being replaced with carbon dioxide fixed systems, where personnel are not present or can be evacuated before a system is discharged.

However, the traditional agents do not meet the requirements for replacement of the Essential Uses of halon. A halon-like, clean, gaseous agent is needed. For some applications, enclosures might remain manned during agent discharge and for short periods afterwards. An agent is required which is non-toxic at effective concentrations, and which is discharged rapidly to minimise concentrations of combustion products.

The Montreal Protocol Task Force established the Halon Alternatives Working Group (HAWG) to coordinate the MOD's search for, and evaluation of, suitable halon alternatives for all its applications, Essential and Non-essential. With representatives from all branches of the Department, the Working Group is a useful forum for information exchange and provides guidance to users, guides the Task Force on policy matters and coordinates trials of the leading alternative agents.

In assessing the suitability of an alternative, there are three major issues which must be addressed:

a. The health and safety of personnel who may be exposed to extinguishing concentrations, or lower levels, of the new agents;

b. The environmental acceptability of the new agents, and whether their use is likely to be affected by

existing or future environmental legislation; and

c. The fitness for purpose of the new agents, to ensure that they provide an adequate level of fire protection and that they are compatible with the equipment concerned.

The responsibility for each of these issues lies with different branches of the Department. To ensure that all issues are properly addressed, a clearance procedure, coordinated by **HAWG**, has been established. Only those agents which have been cleared by the appropriate authorities are acceptable for use by MOD.

The health and safety risks to personnel who might be exposed to the agent are assessed by the Institute of Naval Medicine, which acts as a tri-service authority in the matter. ***So*** far, that assessment has been based upon submissions of information from the agent manufacturers, but the Institute has the facilities to undertake additional trials if these are deemed necessary. The Institute recommends agents for approval, or otherwise, by the Surgeon General, subject to any constraints considered necessary.

The environmental acceptability of the agent will be assessed by the MOD's Environment Group – IL(Log). Existing and foreseeable legislation will be taken into account to ensure that MOD does not adopt, wherever avoidable, an alternative that may face restrictive legislation or a reduced service life. Recommendations will be made for AUS(IL) approval, or otherwise.

The fitness for purpose of new agents in particular installations will be assessed by the user or, on his behalf, by the Design Authority of the equipment concerned. It may be necessary to undertake trials **of** a range of alternatives to find the most effective, and to ensure that an adequate level of fire protection is obtained. This will not necessarily be the same level of protection afforded by halon 1211 or **1301**. Only the user, or Design Authority, can issue approval for a new agent's use **in** a specific application.

In summary, the central clearances from the Surgeon General and AUS(IL), and the specific approval of the user or Design Authority, are needed before any agent can be adopted by MOD as a halon replacement.

At present, a batch of agents has been assessed by the Institute of Naval Medicine and by the Environment Group. However, the required central approvals have not yet been obtained and so full details of the proposed clearances, which are subject to confirmation, cannot be released at this stage.

The agents are:

Water mist
Inergen
Argonite
Argon/nitrogen or a combination of the two
FM200
FE13
CEA 410

All have been assessed as suitable for use in unmanned or normally manned spaces, provided personnel are not exposed to concentrations above certain levels. This assessment does not take account of hazards posed to personnel by interaction of the agents with any fire, which can only be assessed on a case-by-case basis. However, it is recommended that all personnel evacuate an enclosure as soon as fire is detected, preferably before an agent is discharged, and certainly not linger where both agent and fire are present.

Water mist and the inert gases have been assessed as environmentally acceptable, without restriction. There is some concern over possible legislation which might affect use or long-term viability of systems using hydrofluorocarbon or perfluorocarbon agents, because of their global warming potential and long atmospheric lifetimes. There is unlikely to be an MOD ban on their use, because, for certain applications, they may offer the only solution in the short term. However, it is likely that users will be recommended to consider other alternatives wherever possible.

Further agents will be considered for clearance as they are marketed or as they are offered by industry for use in new equipments. FE25 and CF_3I, for example, are of interest for certain applications and will be assessed in the near future.

Agents which will be unacceptable to MOD, on environmental grounds, include any chemical with a significant ODP, whether controlled by the Montreal Protocol as it currently stands, or not. Halon 1011, chlorobromomethane, is one such example, though for this chemical, concerns about toxicity and effectiveness in certain applications reinforce this position. HCFCs have not been cleared for use as fire extinguishants in any country in the European Union. EC Regulation 3093/94 implements the Montreal Protocol in member countries and imposes additional controls on HCFC usage. HCFCs are, therefore, unacceptable as fire extinguishants in MOD.

The fitness for purpose of any fire protection system is the responsibility of the user or Design Authority. Increasingly, the Design Authority for MOD equipment is a contractor in private industry, and the responsibility for

selection of an alternative lies there, rather than with MOD. However, there are areas where the Design Authority is within MOD, such as with ship systems, or where existing systems are being considered for conversion, where MOD trials of new agents are required.

The branches of the Procurement Executive responsible for Armoured Fighting Vehicles (AFVs) have collaborated in funding Defence Research Agency trials of short-listed halon alternatives (CF_3I, FM200, FE25, CEA 410, CEA **614,** dry chemical and AFFF) for protection of AFV engine compartments. The normal operational requirement is that the fire protection system should be able to extinguish a pool fire in the base of the compartment, with or without the engine running.

A rig simulating the engine compartment of a Challenger main battle tank was constructed. A large fan could create the air flow through the mock-up compartment to simulate the conditions observed when a real vehicle's engine is running. The gaseous agents were first tested using existing halon 1211 pipework and maximum bottle capacities – to assess the practicality of retrofitting existing vehicles. The most promising were then tested, along with the non-gaseous alternatives, using manufacturers' recommended distribution and storage systems.

In line with expectations, only CF_3I offered a performance comparable to halon 1211 using the existing halon pipework and bottle capacities. FM200 reliably extinguished fires provided that the rig's forced air flow was switched off. With forced air flow, the quantity of agent that could be stored in the available space was insufficient for effective extinguishment.

With an optimised distribution system, larger capacity storage cylinders and a higher operating pressure, FM200 offered acceptable performance, with and without forced airflow. However, the dry chemical agent (Dessikarb) was the most effective extinguishant, by weight and volume, of those trialled. Either option would be acceptable for new vehicles, or for existing vehicles if the required extensive modification was feasible.

The Royal Navy's Equipment and Systems 225 branch, as part of a cooperative effort with the **US** and Canadian Navies, has commissioned the **UK** Fire Research Station to evaluate low pressure (<10 bar) water mist systems for protection of warship main machinery spaces. This has demonstrated the feasibility of low pressure systems and has shown that a combination of small and large droplets is required for effective fire extinguishment, the former to interact with the flame, the latter to cool the fuel surface.

The second phase of the project will characterise and evaluate a range of commercially available systems using a large scale rig to recreate the conditions in a ship machinery space. The most promising systems will be tested to optimise factors such as operating pressure and water delivery rate.

Although water mist is showing considerable promise as a halon alternative in this application, it is unlikely to offer the same degree of protection as halon to all areas of a large enclosure. However, 100% effectiveness throughout a machinery space, though desirable, may not be essential. Systems which are specifically designed to protect high risk zones or equipments, or control a fire rather than totally extinguish it, may be sufficient to allow trained fire fighting crews to enter a compartment to finish the job. Under the latter circumstances, water mist offers many advantages over a halon-like gaseous agent.

New technological developments in fire protection offer much hope. However, in the longer term, if **MOD** is to replace all its halon, gaseous agents better than the current range of halocarbons are needed. The HFCs and PFCs are not ideal, in terms of environmental acceptability, decomposition product toxicity and extinguishing performance. The Department is reliant upon developments in industry and other military establishments, especially in the United States, in meeting its aims in this respect. **MOD** will, therefore, be watching developments closely and be actively involved wherever it can.