

PETRONAS TECHNICAL STANDARDS
HEALTH, SAFETY AND ENVIRONMENT

HALONS ALTERNATIVES
(GUIDELINE)

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1.0 **INTRODUCTION**

Since the document "Recommendations for Alternatives to Fire Fighting Halons" was issued in 1990 a number of new developments have taken place in the field. This document gives up to date guidance on ways of phasing out Halon usage for fire fighting purposes and possible alternatives that can be used.

The main thrust of this document is to encourage the identification of hazards and an assessment of risks before replacing Halon systems with those of alternative agents. In many modern facilities fixed fire protection systems are not always essential if other preventive steps to control hazards that could result in a fire have been taken, especially when effected at the design stage.

Where fixed fire protection systems are deemed necessary the guidance encourages users to employ environmentally benign extinguishing agents (water, carbon, inert gases etc.) wherever practicable.

Any Halon phase-out programme should always include a fully worked out disposal or recycling plan for the decommissioned Halon and the associated hardware.

2.0 **BACKGROUND**

Halons have given excellent service over the last 25 years in protecting personnel and assets from fire. They have been used in portable extinguishers, local application or total flooding systems. Since they contribute to depletion of the ozone layer, the Montreal Protocol (Revised 1992) has required the manufacture of Halons to cease from 1st January 1994 in signatory countries.

Although Halon stored in the sealed containers of a fire protection system cannot harm the environment directly, in the spirit of the Montreal Protocol, every practicable effort should be made to phase-out the use of Halons in a timely and cost effective manner. Every effort also needs to be made to prevent leaks and inadvertent discharges prior to or during phase-out. The Montreal Protocol does not set any deadlines for the phase-out of Halon usage, only for the cessation of its production.

3.0 HSE CONSIDERATIONS

3.1 FIRE SAFETY

Any Halon removal programme, developed to meet the needs of a specific installation or facility, will need to make sure that in the process of phasing out Halon usage, the level of fire protection provided to personnel and assets is not decreased. Halon system removal plans should include identification of fire hazards and potential consequences to ensure that alternative measures are appropriate and adequate. Simply substituting or replacing Halons uncritically with other extinguishing agents or systems is an inadequate and non cost-effective fire safety response and should be avoided. Conventional Halon systems provide a combined detection and extinguishing action. Fire risk assessments often indicate that in many cases a detection only function can permit adequate protection.

3.2 HEALTH

Choice of alternative agents to Halons should always take health effects into account. In general those agents chosen should be of low toxicity to personnel both in terms of their No Observable Adverse Effects Level (NOAEL) and their Lowest Observable Adverse Effects Level (LOAEL). These levels should be looked at in the context of the agent extinguishing concentrations required.

3.3 ENVIRONMENT

When handling Halons every effort should be made to prevent their inadvertent release to the atmosphere. All reasonable measures should be taken to transfer decommissioned Halon stocks to support systems still in service or to a local/international Halon bank or another bona fide user. In general, Halons should not be destroyed unless they are contaminated to a degree that makes recycling impracticable. Alternative fire protection agents should be chosen with due regard for their environmental impacts such as toxicity, ozone depletion and global warming potential.

3.4 DISPOSAL OF HALONS

Transport of decommissioned or recycled Halon may also be covered by legislation and operators should make sure that Halons are disposed of through organizations licensed to handle or transport them. This is especially important where national borders may be crossed.

Where destruction of contaminated Halons is deemed to be necessary, operators should make sure that it is carried out by an organization licensed by the local authorities to process waste in this way.

There are considerable benefits to be gained from co-operating with other local industries and organizations. National and international organizations involved in managing Halon supply, demand and disposal can also provide assistance e.g. local

Halon banks, E&P Forum Halon Referral Service etc. Appendix 2 lists contacts for national Halon banking activities.

4.0 LEGISLATION

In some areas of PETRONAS OPUs Halon systems are still called for by legislation. It is necessary to ensure appropriate exemptions from legal requirements of this type when continuing using or taking such systems out of service.

Existing of future government legislation, or changes to the Montreal Protocol, may restrict the application of some halon replacements rendering them commercially no-viable. For this reason it is important to be continually aware of current legislation.

5.0 ASSESSING FIRE RISKS IN NEW OR EXISTING FACILITIES

When phasing out Halons and deciding whether an alternative extinguishing system is justified, a simple fire risk assessment study should be carried out. Hazards that could result in a fire should be identified followed by a review if causes and consequences. The risks should be analysed to see if they are tolerable in the context of personnel exposed, local conditions and operating philosophy. Where risks are assessed as not as low as reasonably practicable they should be reduced using control and recovery methods as appropriate. Guidance on techniques is given below.

5.1 DESIGN OUT HAZARDS AT SOURCE

This approach is most appropriate at the design stages of an installation. It usually involves use of non-combustible materials of construction, equipment design and layout considerations, elimination of ignition sources and other measures that keep the possibility of a fire starting and its consequences as low as reasonably practicable.

5.2 REVIEW PROCEDURES

Maintenance and housekeeping procedures should be reviewed to see that fire hazards encountered in the course of general maintenance are recognised and addressed. Typical examples are curing leaks of combustible liquids or gases, removing and replacing oil soaked insulation or similarly contaminated materials, monitoring that good housekeeping methods are used, avoiding the accumulation of combustible waste and controlling or eliminating potential ignition sources wherever possible.

5.3 DETECT INCIPIENT FIRE CONDITIONS

The use of sensitive smoke detection techniques to monitor pre-fire conditions can frequently permit a fire prevention response before the fire has actually started. This can be achieved using very early smoke detection apparatus type systems, aspirated smoke detection or sometimes by careful selection and location of point smoke detectors to achieve optimum sensitivity. Highly sensitive smoke detection systems operate by smoke sampling which overcomes many of the problems of barrier layer effects and high air flows which can defeat conventional point detectors. Systems of this type can be used alongside the usual electrical protection devices to remove electrical power (ignition energy source) from the facility or to alert personnel and permit manual intervention if a pre-fire condition is detected.

5.4 USE PASSIVE PROTECTION

Enclosures can be designed to withstand fires for a given period and protect critical equipment. In addition low flame propagation cabling and non-flammable stopping of cable ducting etc. can prevent fire spread to other areas. This type of measure limits fire spread and allows time for manual intervention.

5.5 USE ACTIVE PROTECTION

Where the above measures are considered unlikely to control fire hazards and their potential consequences to an adequate degree then an alternative to a Halon system may be considered.

6.0 CHOOSING AN ALTERNATIVE OR REPLACEMENT FOR HALONS

6.1 GENERAL REQUIREMENTS FOR HALON ALTERNATIVES AND REPLACEMENTS

Halon 1211 has traditionally been used in local application systems and can be used in the open air as it is applied as a liquid stream projected into the fire. It is used in portable extinguishers and in fixed systems on floating roof tanks to extinguish fires in the seal area.

Halon 1301 has, in contrast, been used principally in total flooding systems and being a vapour at atmospheric pressure it has been best suited to protection of enclosed spaces.

The chemical industry has been very active in developing alternatives to Halon extinguishing agents although most are still in the development phase. Although small numbers of the new compounds are being actively marketed by chemical companies there is the possibility that their use will be limited or even banned in time as their effect on the environment is better understood. Investing in new systems using these agents therefore is not without risk.

Wherever practicable, environmentally benign extinguishing agents should be considered

e.g. water, carbon dioxide, inert gases etc. as these agents do not incur significant lifetime environmental management costs or risk being targeted for phase-out in a few years time. A review of potential health risks should also be taken into account when selecting alternative agents to Halons.

Appendix 1 contains a list of typical applications for preferred Halon alternatives. Appendix 4 contains specific data on halocarbon, inert gas, water mist and high expansion foam systems.

6.2 REPLACEMENT GASEOUS AGENTS CHEMICALLY SIMILAR TO HALONS

Where fire extinguishing agents, which are chemically similar to Halons, are considered as Halon replacements they should meet certain criteria as follows:

- have an Ozone Depletion Potential (ODP) of zero (to avoid being subject to current or future phase-out legislation)
- have low toxicity to personnel in terms of NOAEL and LOAEL

In addition, during the selection process the criteria of Global Warming Potential (GWP) and atmospheric lifetime should be considered, since these properties may be subject to future legislation. General guidance for exposure to these types of agents in total flooding applications is given below:

- Where egress from an area cannot be achieved within one minute agent concentrations used shall not exceed its NOAEL.
- Where egress from an area takes more than half a minute but less than one minute agent concentrations used shall not exceed its LOAEL.
- Where, to achieve an extinguishing concentration, an agent has to be used at levels greater than its LOAEL it shall only be used in not normally occupied areas on the proviso that any personnel who happen to be present during discharge can evacuate in least than half a minute.

Currently, two agents suitable for total flooding application that generally meet the above criteria for replacement agents similar to Halons are HFC 227ea & HFC 23. Details of these along with other development compounds are given in Appendix 4.

It is unlikely there will ever be a "drop in" replacement for Halon 1301 but the molecule CF31 (Halon 13001) has shown promise as a combustion chain breaker (like Halon 1301 but unlike the HFC compounds) and appears to have a short atmospheric life suggesting that it may represent a minimal threat to the ozone layer (ODP conservatively estimated at 0.008). As yet it is not available in commercial quantities and more development work is needed including further toxicity studies following disappointing early results.

6.3 ALTERNATIVE GASEOUS AGENTS NOT SIMILAR TO HALONS

Alternative gaseous fire extinguishing agents for total flooding systems normally comprise carbon dioxide, argon-nitrogen mixtures or pure argon gas.

Carbon dioxide is a well known agent of proven performance but not suitable for automatic systems unless precautions are taken to protect personnel who may be present from exposure to a discharge.

Argon and argon-nitrogen mixtures (IG-55) are usually treated in the same way as carbon dioxide although they do not exhibit its physiological effects and as a result, do not interfere with the human control mechanisms for the respiration process.

The argon-nitrogen inert gas mixture (IG-541) includes a small percentage of carbon dioxide to stimulate respiration in reduced oxygen atmospheres and is suitable for automatic release into areas occupied by personnel. Where rapid fire development is a possibility automatic operation may well be justified. If fire development is likely to be slow it may well be appropriate to keep the system under manual control. Normal, immediate evacuation procedures in case of fire or accidental discharge of IG-541 (Inergen) should always be followed.

The US Environmental Protection Agency (EPA) have accepted inergen as part of their Significant New Alternatives (to Halons) Programme (SNAP). There is little