CLEAN AGENT HALON REPLACEMENTS

INTRODUCTION

AXA XL Risk Consulting insures many facilities in the electronics, telecommunications, research, defense and aerospace industries, all of which have special fire protection needs because they are so susceptible to contamination. Since the initial use of halon as a commercial extinguishing agent, AXA XL Risk Consulting has been very particular about design and installation practices and has insisted on very thorough acceptance testing. Over the years, these efforts have resulted in improved, more effective systems.

The use of halon has vastly declined since halon was first suspected of being an ozone depleter. The speed of this decline was hastened by the position taken by AXA XL Risk Consulting on May 12, 1989 to stop recommending halon in insured properties. On November 25, 1992, the Montreal Protocol was amended by international consensus to stop halon production by January 1, 1994. Many potential halon users have since decided to use other agents for their basic protection needs.

POSITION

Many hazards previously protected by halon can be protected by sprinklers alone or in combination with an alternative clean agent. AXA XL Risk Consulting does not recommend any specific clean agent but will generally recommend that gaseous agent systems be used where appropriate. Consider only listed clean agent systems or those in the process of listing. Include a thorough acceptance test in system cost.

For a clean agent system to be acceptable to AXA XL Risk Consulting, the following must apply:

- Agent viability has been proven for the specific hazard.
- The agent must be acceptable to the United States Environmental Protection Agency (USEPA).
- The agent and system installation must be in compliance with NFPA 2001 as interpreted by AXA XL Risk Consulting. See PRC.13.6.1.
- Equipment must be listed by a nationally recognized testing laboratory such as Underwriters Laboratories Inc.
- System performance has been demonstrated.

Status Of Existing Systems

In certain jurisdictions, Halon systems may remain in service provided the system is properly maintained. Some jurisdictions, however, have mandated the removal of Halon systems. The

European Union mandated the decommissioning of Halon systems by December 31, 2003, except for except for “critical uses”, such as certain military or aerospace uses.

In jurisdictions where Halon use is still permitted, special precautions should be taken. Corporate management should have its halon phase-out plan of action ready for implementation. If halon systems are to remain in service, inventory all halon systems corporate wide, assess the importance of each system, and determine the quantities of replacement agent that may be needed in the foreseeable future. Locate sources of recycled halon for purchase. Some large companies have purchased halon reserves, which are being held by their local halon distributor.

Many companies are voluntarily decommissioning halon systems because they fear that:

- Future continuation of protection may be jeopardized.
- The environment may be further harmed.
- Government-imposed decommissioning may occur at inopportune time.
- Halon may become a controlled substance requiring costly destruction.
- Halon maintenance costs will substantially increase.

Where halon systems are to be taken out of service, AXA XL Risk Consulting recommends that alternative protection be installed. In many cases, properly designed sprinkler protection may provide sufficient protection. Your local AXA XL Risk Consulting representative can discuss protection alternatives.

If a facility is contemplating removing halon or replacing it with another agent, do not discharge halon into the atmosphere. Contact the local extinguishing system servicing company to obtain appropriate reclaiming and recycling procedures. The Fire Suppression Systems Association (FSSA) has reported several incidences where containers being moved by inexperienced people has resulted in accidental discharge of the container in an uncontrolled manner. The following is an excerpt of their **Safety Alert**:

> “In all of the incidents reported to FSSA the cause of the accidents were attributable to improper handling of the cylinders by untrained and unqualified personnel. In all cases actuating devices had not been removed from the valves and anti-recoil devices and protection caps were not installed prior to removal of the cylinders from service.
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> These unsafe practices pose a threat to life and property. In the interest of public safety. FSSA recommends that the following guidelines be followed:

- IMPORTANT: If any work is to be performed on the fire suppression system, a qualified fire suppression system service company, trained and experienced in the type of equipment installed, should be called to do the work.
- Personnel involved with fire suppression system cylinders must be thoroughly trained in the safe handling of the containers as well as in the proper procedures for installation, removal, handling, shipping and filling; and connection and removal of other critical devices, such as discharge hoses, control heads, discharge heads, initiators and anti-recoil devices.
- The procedures outlined in the Operation and Maintenance Manuals, Owner’s Manuals, Service Manuals, etc., that are provided by the Manufacturer, for the specific equipment installed, must be followed.
- Most fire suppression system cylinders are furnished with valve outlet anti-recoil devices and in some cases cylinder valve protection caps. DO NOT disconnect cylinders from the system piping, or move or ship the cylinders, if the anti-recoil devices or protection caps are missing. Obtain these parts from the Distributor of the Manufacturer’s equipment, or the equipment Manufacturer.
- These devices are provided for safety reasons and must be installed at all times, except when the cylinders are connected into the system piping or being filled.

- All control heads, pressure operated heads, initiators, discharge heads, or other type actuation devices must be removed before disconnecting the cylinders from the system piping; and anti-recoil devices and/or protection caps immediately installed before moving or shipping the cylinders. Most fire suppression system equipment varies from manufacturer to manufacturer, therefore it is important to follow the instructions and procedures provided in the equipment Manufacturer's manuals. These actions should only be undertaken by qualified fire suppression system service company personnel."

System Review

Handle all submittals for review in accordance with established AXA XL Risk Consulting procedures specified in PRC.13.0.2. Design all systems to allow evacuation prior to discharge, since evacuation after discharge could lead to insufficient agent to effectively extinguish the fire. On very rare occasions, the system may be specifically designed to provide protection during evacuation. In those cases, provide an extended discharge taking into account unclosable openings or provide a second complete discharge for property protection once the enclosure is sealed. Also, the agent selection and design should account for exposure limits listed in NFPA 2001.

The review of submittals using equipment in the process of being listed can proceed. The contractor must make any necessary changes to bring the system in conformance with the revised listing requirements as a result of final listing.

System Acceptance

Perform an enclosure integrity test to ensure that the enclosure will not leak excessively and that the enclosure can handle the pressures developed during discharge. Acceptance test all completed engineered installations in accordance with established AXA XL Risk Consulting procedures following PRC.13.0.5, PRC.13.0.5.A and PRC.13.0.5.2.

Discharge tests can still be conducted for inert gas clean agents in lieu of an enclosure integrity test. Discharge tests are typically not conducted for halocarbon clean agents due to the high agent cost. **In any case, it is recommended that no one be in the enclosure during system discharge**.

DISCUSSION

AXA XL Risk Consulting has always been a strong proponent of sprinkler protection for many of the occupancies in which halon protection is often used. In addition, AXA XL Risk Consulting pursues sprinkler protection in combination with most special extinguishing system installations. Sprinklers protect the structure and limit fire spread. The special extinguishing system, on the other hand, may keep fire from developing to the point of opening sprinklers and protects equipment before major damage can occur. With sprinkler protection alone, larger losses are expected due to the damage incurred while waiting for sprinkler head response.

In the computer room environment, if a fire occurs within the equipment, the loss of that piece of equipment can be expected before sprinklers operate. That same piece of equipment may have been saved if a special extinguishing system had operated first. Fires which occur outside of computer equipment can be protected efficiently by overhead sprinklers; however, sufficient heat may be generated to damage equipment and sensitive data media. Carbon dioxide systems have provided effective fire extinguishment in unoccupied spaces such as underfloor areas where there may be insufficient space for effective sprinkler distribution.

Recognizing that most Halon 1301 applications are for computer room occupancies, AXA XL Risk Consulting is reaffirming its position that wet pipe sprinkler systems conforming to NFPA 13; smoke detection conforming to NFPA 72 with interlocks to shut off computer room power, where appropriate; an underfloor carbon dioxide system conforming to NFPA 12 and PRC.13.3.1 is acceptable protection. In some cases, carbon dioxide may be used inside equipment enclosures.

Agent Acceptable to the USEPA - The USEPA released the Significant New Alternatives Policy (SNAP) report in The Federal Register on May 12, 1993. The report addresses the new clean agents

and indicates the restrictions that are placed on them by the USEPA. It will be updated as other new agents are submitted. See Table 1 for information on agent identification.

The evaluation of these materials from a toxicity and physiological effects standpoint requires an understanding of some of the terminology. For halocarbon agents the No Observable Adverse Effect Level (NOAEL) is the highest concentration at which no adverse physiological and toxicological effect was observed on animals under test. The Lowest Observable Adverse Effect Level (LOAEL) is the lowest concentration at which an adverse physiological and toxicological effect has been observed on animals under test. The major effect normally observed is cardiac sensitization.

TABLE 1
Clean Agent Identification

Agent	Chemical Name	Trade Name	Primary Manufacturer
HFC-23	Trifluoromethane	FE-13	E. I. DuPont
HFC-227ea	Heptafluoropropane	FM-200	Chemtura
		FE-227	E. I. DuPont
IG-01	Ar	Argon	Minimax
IG-55	N_2 and Ar	Argonite	Ginge-Kerr
IG-541	N_2, Ar and CO_2	Inergen	Ansul
FC-3-1-10	Perfluorobutane	CEA-410	3M
CFI 1311	Iodotrifluoromethane	Triodide	Pacific Scientific
HCFC Blend A	Blend of 3 HCFCs and a scavenger	NAF S-III	North American Fire Guardian
HFC-125	Pentafluoroethane	FE-25	E. I. duPont
		Ecaro-25	Fike
FK-5-1-12		Novec 1230	3M

The health concern for inert gas clean agents is asphyxiation due to lower oxygen levels. For inert gases the No Effect Level (the functional equivalent of the NOAEL) corresponds to 12% minimum oxygen. The Low Effect Level (the functional equivalent of the (LOAEL) corresponds to 10% minimum oxygen in the atmosphere.

Clean agents acceptable to USEPA for total flooding applications include:

- **HFC-23** is acceptable for use in normally occupied areas, normally nonoccupied areas, inerting and explosion suppression systems.
- **HFC-227ea** is acceptable for use in normally occupied areas, normally nonoccupied areas, inerting and explosion suppression systems.
- **IG-01** is acceptable for use in normally occupied areas, normally nonoccupied areas and, inerting.
- **IG-55** is acceptable for use in normally occupied areas, normally nonoccupied areas and, inerting.
- **IG-541** is acceptable for use in normally occupied areas, normally nonoccupied areas and, inerting.
- **FC-3-1-10** is acceptable for “Specific Uses” only. Specific uses as defined by the USEPA are “applications involving the protection of public safety or national security; telecommunications or computer related equipment related to public safety or national security; life support functions; and for explosion inertion/suppression with flammable liquids and gases.”
- **HCFC Blend A** is acceptable for use in normally occupied areas, normally nonoccupied areas and explosion suppression systems. This is a Class II substance which is expected to be phased out by the year 2030.
- **HFC-125** is not acceptable for use in normally occupied areas, but is acceptable for use in normally nonoccupied areas, and explosion suppression systems.

- **HBFC-22B1** is acceptable for use in normally occupied areas, normally nonoccupied areas and explosion suppression systems. This substance is expected to be phased out by January 1, 1996.
- **CFI 1311** is not acceptable for use in normally occupied areas, but is acceptable for use in normally nonoccupied areas, and explosion suppression systems.

System Compliance with an NFPA Standard - NFPA 2001 restricts the use of the clean agents at concentrations with relation to the NOAEL and LOAEL levels. Clean agents may be used at concentrations up to the NOAEL in normally occupied spaces. In no case should the exposure exceed 5 minutes. For concentrations exceeding the NOAEL, exposure times should be limited in accordance with NFPA 2001, Section 1.5.1.2. for Halocarbon agents and Section 1.5.1.3 for Inert Gas agents.

Agent discharge should be delayed to allow for evacuations prior to discharge. Delaying agent discharge for a nominal period controls loss of agent by allowing time for:

- People to evacuate safely before the agent is discharged.
- All doors to close.
- Ventilation dampers, including electro-thermal links (ETLs) on damper releases to operate.
- Ventilation fans to shut down and fan blades to stop moving.
- Sounding pre-discharge alarms.

The rescue of incapacitated individuals could take 10 min or more. Personnel providing rescue should not enter the protected space during or after agent discharge without proper protective gear.

For flame extinguishment, NFPA 2001 requires the minimum design concentration for Class B fuels be at least 20% higher than the extinguishing concentration for the specific fuel, determined by test, using a cup burner apparatus. The minimum design concentration for surface fire Class A fuels must be at least 20% higher than the extinguishing concentration determined by test as part of the equipment listing procedure. Presently there are no test procedures in NFPA 2001 to determine minimum design concentrations for deep seated fires.

NFPA 2001 does not support performing a discharge test as part of the overall system acceptance. In today's more environmentally aware society, it is difficult to justify discharging materials into the environment. To replace the functions of a discharge test, it is necessary to evaluate what the discharge test determines:

- **Room tightness** - The ability to reach and hold the minimum specified concentration until the fire is completely extinguished and the fire department has arrived. This can be confirmed by periodic door fan testing if appropriate design constraints are enforced. The door fan test can be used to evaluate the tightness of single compartment rooms. Complex rooms with interconnected openings must be avoided.
- **Integrity of the piping system during the thrust of discharge** - Static pressure testing can identify major sources of weakness in the integrity of the piping system. Puff testing only proves that a path exists from the pressure source to the nozzles. Dynamic pipe movement is not tested; therefore, pipe supports and bracing must be carefully designed to ensure that no hazardous pipe movement occurs.
- **Accurate agent mixing in the protected area** - Lacking a discharge test, there are some features to enhance confidence in the overall system. It is imperative that the listing organizations investigate agent characteristics such as the agent's gasification efficiency, its stratification effects, the effects of obstructions, and agent settling. These characteristics should be evaluated by standard test methods in the laboratory environment.
- **Operation of the container discharge apparatus** - Although internal dip tubes and check valves operate during an actual discharge, there are few problems with these devices as a result of extensive testing associated with equipment listings.

Equipment Listed by a Nationally Recognized Laboratory - Equipment must be listed by a nationally recognized testing laboratory such as Underwriters Laboratories (UL). Part of the approval system includes preparation of the final design manuals. Design manuals can be obtained from the equipment manufacturers.

Development of Test Parameters, Procedures and Equipment - The system must be in compliance with PRC.13.6.1. Many features of a special extinguishing system installation require review. The first and most important is the appropriateness of the agent selected. Review history of prior installations, extinguishment and false trips. There is as yet little practical experience with these new clean agent systems. The testing associated with the listing of a manufacturer's product is limited and does not necessarily represent the full system capabilities.