HALON FIRE SUPPRESSION SYSTEM DEMONSTRATION

FOR THE ALASKAN BUSH

INTERIM REPORT

by

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INTRODUCTION

Water sprinkler systems have long been the accepted means of fire protection for buildings which are normally occupied by people. The system has proven to offer the best protection for the structure most economically, while not endangering the occupants. In bush Alaska however, water utilities are often not available, which inflates the system installation and maintenance costs considerably, and buildings are often elevated wooden structures which sustain considerable damage if the sprinklers are activated. If poorly maintained, as can often be the case in remote areas, the system is prone to operational failure or freeze damage. Fire insurance rates for bush areas reflect both the relative unreliability of and the water damage caused by sprinkler fire protection systems.

An insurance adjuster in Bethel since 1974, John Malone, who is also closely associated with hostels, run by Bethel Social Services (BSS), was well aware of this paradox. He, with the aid of an electronics technician, Don Porter, initiated the search for a viable alternative to the water sprinkler system and through their efforts, gained permission from the State Fire Marshal to modify and install a Halon system in the BSS Halfway House. Funded as a research demonstration by the State Legislature, the project has been monitored by the Department of Transportation and Public Facilities Research Section from the onset.

The following report was written in January 1981 as a final inspection of the installation, in the form of a letter to the files. However, now after six months of operational status of the Halon system, it was felt that it is comprehensive enough to be published as an interim report. The system has survived its first crisis, operating as designed. (Two small fires set off the detection/alarm system and were contained by conventional fire extinguishers without having to use the Halon.) The comprehensive report referred to on the last page of the text will still be forthcoming after additional experience with the system is gained.
TO: Files

FROM: John F. Rezek
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January 28, 1981
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Final Inspection &
Interim Report
Bethel Halon Demo

On January 14th, 1981, I traveled to Bethel to conduct the final inspection of the Halon Fire Suppression system installed in the Bethel Social Services (B.S.S.) Halfway House under contract with DOT/PF Research. I was received at the project site by Vicki Malone, Administrative Director of Bethel Social Services and John Malone, co-design modifier and installer of the Halon System. The principal engineer of the modifications and installation, Don Porter, was not in town.

The Halfway House is a wood frame single story structure, 60' x 60' (3,600 ft²), elevated approximately four feet off a gravel pad by a mudsill/post foundation. The building is connected to sewer utility, but has its own well for domestic water. The well house is of similar construction and is located some 15 or 20 feet from the east wall of the main building. This structure also houses the oil furnace/boiler which provides heat and hot water to the buildings.

The building houses up to sixteen men and women in six bedrooms. There is a large common area (700 ft²) in the southwest corner and a kitchen, men's and women's baths, and laundry located in a central core surrounded by the corridor (5 ft. wide) to the dorm rooms. The Director and her family live in a small (730 ft²) two bedroom, self-contained, apartment located in the northeast corner of the building. There are two exits from the common room and one from the apartment. These doors are equipped with automatic closers, as are the interior doors to the laundry, bathrooms, and the apartment. The windows in the apartment and bedrooms are designed for emergency egress; those in the common area are fixed and designed with solar heat gain in mind, though they do not incorporate insulated shutters.
The building design (by John Malone) is fairly energy efficient; 9\(\frac{1}{2}\)" fiberglass insulation in the walls and 12" in the floor and ceiling, triple pane windows (though the building contractor has not yet installed the third pane), no exterior wall electrical boxes (power is provided to those walls by electrical plug-in strips), and double door "Arctic Entries", at each exit. Ventilation requirements are minimized by use of electrostatic precipitators.

The Halon installation is essentially a unique design modification by Don Porter and John Malone of a Kidde Model 2400 panel/system. (It is actually a "second generation" system, resulting from improvements to modifications done by Mr. Porter and Mr. Malone on a Kidde Model 2400 which they installed in 1979 in the Bethel Social Services Receiving Home). The unmodified system is designed for industrial application; apparently no residential use system is commercially available from any source. The deficiencies of the commercial models for use in a residential situation are mostly in the area of possible inadvertant dumping of the Halon due to vandalism or false alarms. Accidental release of the Halon in itself is not serious; it has a "least-toxic" life hazard classification by Underwriter Laboratories, is odorless, colorless and non-corrosive. However, it is fairly expensive to recharge the bottles, (about $4200 for the Halfway House System) and of course, the fire suppression function of the system is disabled until it can be recharged. The modifications, which Mr. Porter and Mr. Malone have engineered, minimize the chance of accidental or deliberate non-emergency dumping of the Halon, without jeopardizing either the safety of the residents or the intended fire suppression function of the system.

The system, as manufactured by Kidde, consists of an alarm system and time delay system, which are activated by sensing devices or pull stations. At the end of the time delay, the system dumps unless a silence/abort switch is flipped. The system is reactivated by operation of several switches, which, if the proper sequence is not followed, can cause accidental discharge of the Halon. Access to the silence/abort switch is by key to the panel cabinet. The modification of the stock
system separates the ionized detection alarm circuit from the heat sensor/pull station Halon dumping circuit, provides means of silencing the alarm without disarming the system, and simplifies the system abort/rearm operation should the alarm prove false.

More specifically, if any of the ion smoke detectors are activated, a small amount of current is rectified, triggering the alarm bells, alerting the residents. After the supervisor evacuates the inmates, he or she can silence the alarm with a switch located externally on the cabinet without disarming the system, allowing a search for the cause of the alert without the added stress of the loud bells. If the alarm was false, the system is easily rearmed by turning the alarm back on and holding down a reset switch in the cabinet.

However, if during this search one of the rate-of-rise/heat detector (15°F/ min. and 135°), which are co-located with the smoke detectors and Halon bottles in each room, is activated a horn comes on signaling that the Halon will be dumped in 30 seconds. If the fire is found to be in one of the dorm rooms that have individual pull stations, that room can be closed off and the Halon to it dumped independently from the rest of the system. The supervisor can then use the "Save Halon" switch at the control panel (also located external to the cabinet) so that the rest of the system is preserved. If, on the other hand the fire is not in one of these isolated rooms or is not observed at all, the Halon will dump from all sixteen 40 lb. bottles at the end of the 30 second period or they can be dumped immediately as the supervisor leaves the building by use of the pull station located at each exit.

A couple of other features have been incorporated by Mr. Malone and Mr. Porter. One is a "timer recycler" located between the central kitchen and the common room, which resets the timer for another 30 seconds should the supervisor determine there is no need to dump the system, but needs more time to get back to the control panel to abort the dump. The other is that when the pull station boxes are opened the alarm bells go off, hopefully discouraging vandalistic dumping of the Halon.
Rearming of the system after an aborted alert is identical to that for the false alarm reset. If the Halon dumps, of course, the bottles must be removed and recharged or exchanged for full ones. While this is being done the fire suppression system is gone, but the alarm system is not impaired. Recharging of the system (via Anchorage) should be able to be accomplished in 48 to 72 hours. (Next year they expect to have on-site recharging capability reducing recharge time to less than 24 hours).

The controversy of using Halon for residential fire protection seems to be based mainly on cost and the fact that the industry does not design such systems. This system, as installed, counters very well both those arguments.

The usual fire protection system for residential (dormitory, motel, etc.) use is water sprinklers. There is no question that the sprinkler system is far cheaper to install than a Halon system giving the same level of protection if the system is installed where water utilities are available. If there are no water utilities, a 10,000 gallon pressure tank is required (for a building the size of the Halfway House). The estimated (contractor's low bid) cost of hardware for a sprinkler system in the B.S.S. receiving home (about the same size structure as the Halfway House) without installation was $16,000. Assuming the bid would be about the same for the Halfway House, the $17,000 cost of the Halon hardware compares equally. Installation cost is also close to the same for each. The water system, however, requires continual costly maintenance; the Halon system is virtually maintenance free.

The drawbacks due to industry's design being for industrial use, have been pretty well addressed by the modifications above. No fire protection system is vandal proof, but whereas use in a residence such as the Halfway House may increase the exposure to vandalism, it also provides it with closer surveillance by the supervisors.

Other negative comments deal with personnel safety and reliability of the Halon to suppress a fire.
On the first note, the National Fire Protection Association (NFPA) indicates that a Halon concentration greater than 7% may not be used where egress cannot be accomplished within one minute. Several toxology laboratories (e.g. Hine and Haskell Laboratories) have determined that exposures of human subjects to concentrations of 10% for 3-4 minutes had no serious effect. This system uses a 5½% Halon concentration. There may be a degree of danger to a person in close proximity to a discharging nozzle due to the sudden release of a very low temperature gas and the possibility of inhaling a high Halon concentration before it can disperse completely. This danger, however, is relatively remote as the pre-dump warning of the system allows adequate time to evacuate well in advance of the dump. In the event that an individual is thusly exposed, the effect would be temporary.

There is a chance that if the Halon is exposed to flame or hot (+950°F) surfaces for a prolonged time, noxious compounds (hydrogen fluoride [HF] and hydrogen bromide [HBr]) may be formed, which are respiratory, eye and skin irritants. Whereas this presents a hazard, exposure of only a few minutes is not severe. Since the building should be evacuated by residents before this can occur, the hazard would be mostly to the firefighters who, if informed to the potential danger, will be equipped with respirators, as they would for any noxious smoke or fumes. The potential for noxious products of decomposition of the Halon could be lessened by increasing the concentration, but then we are back to the original safety problem.

As far as reliability of the system, only an incident will tell for sure. The 5½% concentration should extinguish or at least suppress most household type fires except for a deep seated one such as in a mattress or couch cushion. Water extinguishers are located around the building for such fires. A water sprinkler system works well on those and flare-up fires such as with curtains, etc. They do not, however, work well on electrical, grease (cooking) or petroleum product fires. Halon extinguishes the latter two (if sufficient concentration is released) and the system can easily be adapted to shut off the power.
(though this installation does not do this) in the event of the former. The Halon system operates on a back-up battery system in case of power outage; a sprinkler system is greatly handicapped or is completely disabled with no utility power to run the pump (assuming no utility water).

The rate of rise/heat detectors provide virtually the same level of protection as the heat activated sprinkler heads, plus the pull stations give an added level of protection that the sprinklers do not have. The Insurance Service Office (I.S.O.) in Anchorage has obtained the same fire insurance rate for the Halfway House and Receiving Home as they would have had with sprinkler systems.

As for the reliability of sprinkler systems, there have been two total loss fires in Bethel in recent years involving water sprinkled buildings. Apparently the systems malfunctioned due to poor maintenance. Another Bethel building had the sprinkler system freeze up and burst, causing considerable water damage and leaving the structure (as of this date) unprotected. Hopefully, the maintenance free aspect of Halon makes it overall more reliable than water sprinklers. However, recognizing the experimental nature of this demonstration, even if the Halon system does fail to put out a blaze, the level of detection in this building is so high, that injury due to smoke or fire is remote.

The last major complaint seems to be the high cost of recharging the system. $4200/total dump sounds high and of course is one reason for the abort safeguards in the system, but the building is undamaged by the Halon. In the case of a false alarm or minor fire, the building can be reoccupied immediately and the fire protection restored in a matter of hours. With the sprinkler system the water damage is likely to far exceed the fire damage. In Bethel and many other bush areas, buildings are built up off the ground and utilize fiberglass insulation in the floors. The time and cost of replacing this would be considerable. It could be months before the building could be reoccupied, especially if the incident occurred in the winter. Without even consider-
ing personal and institutional property loss, it seems the cost of a water dump would very likely be much greater than $4200.

Generally, the Halon system, as modified and installed in the Bethel Halfway House, adequately answers most complaints against residential use of Halon. Whether the human factors, such as open windows or vandalism, will seriously detract from its effectiveness are unknown. The greatest problem with widespread bush application of this system is that without qualified innovators such as Mr. Malone and Mr. Porter to make the design modifications and install the system, it practically cannot be accomplished. The Halon industry does not design such systems and has expressed no desire to do so. If these two men or someone equally qualified, were to go into business designing and installing such systems and schooling people to operate them, there might be a bright future for Halon use in the bush. Without that, its expansion to other bush areas is doubtful unless the state makes the commitment to use Halon. Hopefully this demonstration in the Bethel Halfway House will, over time, successfully prove itself. Unfortunately, the only conclusive proof will come from a fire which the Halon extinguishes without harm to the residents.

A comprehensive report on Halon 1301 systems for bush area fire protection will follow after a period of experience with this Bethel Halfway House demonstration system.

cc  Vicki Malone
Larry Sweet