U.S. Department
of Transportation

**Federal Aviation
Administration**

Technical Center

Atlantic City Int'l Airport
New Jersey 08405

August 31, 1994

Dear International Halon Replacement Working Group Member:

This package contains the minutes and information from the July 26-27, 1994, Working Group Meeting held in Seattle, Washington. The July meeting was an informative and successful one.

Task Group #9 concerning a Small Scale Screening Test for Cargo Agents was established at the meeting. The members of the Task Group are: Dave Blake, FAATC-Chairman; Al Gupta, Boeing; Jerry McOlgan, Federal Express; Doug Dierdorf, Pacific Scientific; Sham Hariram, Douglas Aircraft; Carol Sue Chun, Douglas Aircraft; Kevin Frid, GEC Marconi; and Bob Glaser, Walter-Kidde.

The next meeting will be held Tuesday and Wednesday, November 15-16, 1994, at Trump's Castle Casino-Resort in Atlantic City, New Jersey. A special group rate of $78.00 (tax not included) per night has been established for those attending the meeting. Reservations may be made by calling 800-777-8477, #3. Please be sure to give the reservationist the following group code: "AFIRE", to receive the group rate. Reservations must be made and a one night deposit received by the hotel by Friday, October 14, 1994. Further information is included on the ***Meeting Return Form*** included in this package.

We hope to see you in November.

Sincerely yours,

Richard G. Hill
Program Manager

Enclosures

JULY 26-27, 1994 MEETING ATTENDEES

NAME		COMPANY/ORGANIZATION	PHONE	FAX
Gus	Ahlberg	Kidde Technologies Inc.	415-692-7892	415-697-3377
David	Ashby	Boeing Commercial Airplane Company	206-294-3169	
David	Ball	Kidde-Gravner Ltd.	44 753 683 245	44 753 683 032
Harvey	Bayless	Modular Protection Group	913-384-2566	913-384-5935
Jelle	Benedictus	KLM Engineering Dept.	31 20 64 906 31	31 20 64 881 62
John	Blackburn	Avro International Aerospace	061 439 5050 x3696	061 767 3180
Dave	Blake	FAA Technical Center	609-485-4525	609-485-5580
Roy	Boffo	FAA Northwest Mountain Region	206-227-2780	206-227-1181
Jerry	Brown	Spectrex Inc. (ADI)	703-734-9626	703-448-8591
Michael	Bucke	American Airlines	918-292-2388	918-292-3040
Jack	Caloras	Tec-Air Services, Inc.	516-368-2200 Ext. 819	516-368-2218
Alwyn	Carstens	South African Airways	27 11 978 4269	27 11 978 3590
John	Chorba	3M	612-736-7569	612-736-7542
Carol-Sue	Chun	McDonnell Douglas Corp.	310-496-9448	310-593-7104
James	Cinelli	ASC/ENFA (USAF)	513-255-2030	513-255-5677
F.O.	Clark	Boeing Commercial Airplane Company	206-342-5960	206-342-0238
Larry	Cromwell	United Airlines - SFOCE	415-634-4373	
R.H.	Delafuente	Boeing Commercial Airplane Company	206-544-9771	206-544-9697
Doug	Dierdorf	Pacific Scientific	505-291-1109	505-291-1141
Bernd	Dunker	Deutsche Aerospace Airbus	040 7437 5309	040 7437 4742
Larry	Dvorak	Beech Aircraft Corporation	316-676-3497	316-676-3274
P.S.	Ferguson	Boeing Commercial Airplane Company	206-393-0231	206-393-0430
Richard	Gann	NIST	301-975-6866	301-975-4052
Peter	Gibbs	GEC Marconi Avionics Ltd.	44 634 844 400 Ext. 4239	44 634 816 554
Jeff	Gibson	American Pacific Corporation	702-735-2200	702-735-4876
Bob	Glaser	Walter Kidde Aerospace	919-237-7004	919-237-4717
J.H.	Godfrey	Boeing Commercial Airplane Company	206-655-2326	206-655-0934
Martin	Goerl	Great Lakes Chemical Corporation	201-423-5220	201-423-2589
N.H.	Goldstein	Boeing Commercial Airplane Company	206-965-7642	206-965-7744
Thomas	Grabow	Deutsche Aerospace Airbus GMBH	49 421 538 4033	49 421 538 4633
G.E.	Grimstad	Boeing Commercial Airplane Company	206-234-1366	206-237-4831
Kevin	Grosskopf	Applied Research Associates, Inc.	904-283-3734/9708	904-283-9707
Elio	Guglielmi	North American Fire Guardian Tech.	604-684-7324	604-684-7415
Alankar	Gupta	Boeing Commercial Airplane Company	206-237-7515	206-237-5444
Sham	Hariram	McDonnell Douglas Corp.	310-593-4305	310-593-7104
Glenn	Harper	McDonnell Douglas Aerospace East	314-233-6459	314-233-4433
Richard	Harrington	United Airlines - SFOSY	415-634-7207	415-634-7385
John	Harwood	Australian Defense	215-441-2185	215-441-2092
Richard	Hill	FAA Technical Center	609-485-5997	609-485-5796
Tom	Hillman	Kidde Technologies Ltd.	404-751-0835	919-237-9407
Graham	Hodge	Carleton Technologies, Inc.	716-662-0006	716-662-0747
Gary	Holland	Olin Aerospace Comapny	206-885-5000 Ext. 5598	206-882-5749
April	Horner	FAA Technical Center	609-485-4471	609-485-5796
Claude	Houston	Boeing-777 ECS	206-294-3168	
Hans	Humfeldt	Deutsche Lufthansa RG	49 40 5070 2406	49 40 5070 2385
Paul	Huston	Paul O. Huston & Associates	205-655-2961	
Michael	Jaffa	Israel Aircraft Industries	972 3 935 4775	972 3 935 8986
Alan	Johnson	Boeing Commercial Airplane Company	206-655-4138	206-655-0934
Brad	Johnson	Whittaker	510-674-6753	510-671-9840
Dale	Kent	3M	612-733-4931	612-636-1977
Ben	Kerkam	Boeing Military Airplanes	206-662-2160	
Mathias	Kolleck	Booz-Allen & Hamilton	513-429-9509	513-429-9795
Kendall	Krieg	Boeing Commercial Airplane Company	206-237-3167	206-237-3785
Bill	Leach	Naval Air Warfare Center	908-323-1184	903-323-1989

Daniel	Lewinski	Boeing Commercial Airplane Company	206-342-2342	
Claude	Lewis	Transport Canada (AARDH)	613-990-5906	613-996-9178
Richard	Lewis	GEC Avionics Limited	634-816-017	634-816-508
Charles	May	Mass Systems, Inc.	818-337-4640	818-337-1641
Bob	McCracken	FAA	206-227-2118	
Bill	McCutcheon	GEC Marconi Avionics Ltd.	634 816 915	634 816 554
Jerry	McOlgan	Federal Express Corporation	901-369-2462	
Harry	Mehta	The Boeing Company	206-234-3650	206-234-8539
Daniel	Moore	DuPont Fluorochemicals	302-992-2177	302-992-2836
Rick	Morris	FAA Northwest Mountain Region	206-227-2794	206-227-1181
Joe	Muklevicz	Pacific Scientific	818-359-9317	818-359-7013
Tony	Mullard	Fire Protection Consultant	44 753 680 392	44 753 819 224
Gretchen	Nelson	Engineered Fire Systems, Inc.	206-575-3637	206-575-3631
Donald	Nyberg	Olin Aerospace Company	206-885-5000 Ext. 5204	206-882-5747
John	O'Sullivan	British Airways	44 81 562 5460	44 81 562 2928
Rick	Pacey	Embassy of Australia	202-797-3044	202-483-5184
Bob	Painter	South African Airways	27 11 978 3306	27 11 978 3590
A.T.	Peacock	Boeing Propulsion Research	206-294-4642	206-294-4709
Neil	Percival	Percival Associates Ltd.	329 833 814	329 834 013
J.G.	Petkus	Boeing Commercial Airplane Company	206-655-2097	206-655-0934
John	Petrakis	FAA Aircraft Certification	202-267-9274	202-267-5340
John	Ramsey	The Viking Corporation	616-945-9501	616-945-9599
Wallace	Reid	Alaska Airlines	206-433-3378	206-433-3379
Neil	Richardson	Pacific Scientific	818-359-9317	818-359-7013
A.W.	Richter	The Boeing Company	206-657-9720	206-657-9727
Buo	Roduta	United Airlines - SFOCE	415-634-4	415-634-4847
Gus	Sarkos	FAA Technical Center	609-485-5620	609-485-5796
Richard	Sears	Walter Kidde Aerospace	919-237-7004	919-237-4717
James	Simmons	Boeing Commercial Airplane Company	206-342-2355	206-342-5249
Robin	Squires	Pacific Scientific Ltd.	44 628 810252	44 628 810124
Felix	Stossel	Swissair Engineering	41 1 812 6930	41 1 812 9098
Robert	Tapscott	NMERI/CGET	505-272-7252	505-272-7203
Bob	Tetla	U.S. Air Force	904-283-3734	904-286-6763
Paul	Wierenga	Olin Aerospace Company	206-885-5000	206-885-5749
Carole	Womeldorf	NIST	301-975-4415	301-975-4052
Roger	Yurczyk	The Boeing Company	206-237-7350	206-237-5444

INTERNATIONAL HALON REPLACEMENT WORKING GROUP MEETING

Held at

RED LION HOTEL, SEATTLE, WASHINGTON, USA

JULY 26-27, 1994

TUESDAY, JULY 26, 1994

GROUP BACKGROUND/TASK GROUP REVIEW - D. Hill

D. Hill gave a brief overview of the Working Group's objectives and reviewed the Task Groups previously established. He was followed by presentations from leaders of continuing Task Groups.

TASK GROUP #3 - CARGO AREA (TEMPERATURE) - D. Hill

Is there anyone interested in discussing or providing information or data on this task?
Al Gupta (Boeing) will coordinate responses from group for next meeting.
The question to the Task Group is: *In the cargo compartment, what should be the allowable temperatures?*

TASK GROUP #5 - ENGINES - M. Kolleck (Booz-Allen & Hamilton)

Gave update on Engine Survey: within approximately one year this data will be put into an on-line system (access will be on a need-to-know basis). The report has not been published yet because, it has not gone through Public Affairs at WPAFB yet.

TASK GROUP #6 - CURRENT ALTERNATIVE AGENTS - B. Tapscott (NMERI)

A draft of this Task Group's report is included in this package.

Gave update on this Task Group's work. Reviewed some of the possible alternative agents (chemical options to halons). Mentioned recent NIST meeting on halon replacement agents. D. Gann (NIST) gave explanation of NIST Next Generation Technologies Group mentioned by B. Tapscott.

B. Tapscott reviewed the different factors that must be considered in the search for an alternative agent.

D. Blake (FAA Tech Ctr): Do you have a prioritized list of alternative agents for us to use in our current cargo testing?

B. Tapscott: No, we hope to have something soon. We are concerned that our group is such a small group that there will be some bias.

D. Hill: We can distribute the report to the entire Working Group for review if you would prefer that.

TASK GROUP #7- POTTY BOTTLES - B. Glaser (Walter-Kidde)

Reviewed June 27-28, 1994, meeting held at Walter-Kidde and tests conducted and showed diagram of test fixture. A test procedure has been written.

Task Group recommends that crumpled paper hand towels be used as fire load.

D. Hill: The task of this group was to: Find a test method that will demonstrate the ability of an agent to give us the same protection we have now accepted with the halon system in the trash receptacles. The halon system does not always put out the fire.

TASK GROUP #8 - HALON RESTRICTIONS - J. O'Sullivan (British Airways)

This Task Group is responsible for finding out restrictions on halon uses and importation and exportation. J. O'Sullivan explained Basle Convention. He noted that there are different restrictions in the developed countries, the developing countries, and the transient countries.

C. Lewis (Transport Canada): How do countries who are signatories of the Basle Convention handle trade of materials that are considered hazardous in their own countries?

J. O'Sullivan: Reviewed his group's recommendations and suggestions to Basle Convention.

D. Hill: South African airways has a halon recycling facility. What about African countries who want to send their halon to the SAA facility? Can they do this?

J. O'Sullivan: If the other African countries are members of the Basle Convention, they have to conform to the terms of the Basle Convention. I would not like to say how to handle this.

Member Question: Is halon grouped with other hazardous materials or is the Basle Convention citing halon alone?

J. O'Sullivan: Halon is grouped with all the other hazardous materials, and we are trying to draw attention to halon specifically.

Member Question: Does the Basle Convention make a distinction between hazardous waste and hazardous materials?

J. O'Sullivan: I am unable to answer that since I have not seen the entire Basle Convention document.

D. Ball (Kidde-Graviner): This is confusing.

C. Lewis (Transport Canada): At what stage is the Basle Convention? Is the final document signed yet?

J. O'Sullivan: The final document is not signed yet but, the convention is not very receptive to suggestions.

A. Gupta (Boeing): Who made these recommendations?

J. O'Sullivan: These recommendations have been made by the Montreal Protocol Halon Technical Options Committee. We did not have much time to put these recommendations together so, we took the lead from Gary Taylor, the Chairman of the committee. I may have more feedback on this at the next Working Group meeting.

A. Gupta (Boeing): Is it too late to modify these recommendations?

J. O'Sullivan: Yes.

Member Comment: Are you aware that the U.S. is imposing taxes on recycled Halon 1301 entering the country?

G. Nelson (Engineered Fire Systems): There is $43.50 per pound tax on recycled halon being imported into the United States.

J. O'Sullivan: I will take this Working Group's comments back to the Montreal Protocol Halon Technical Options Committee.

FAA TECHNICAL CENTER SUBGROUP LEADER PRESENTATIONS

CARGO COMPARTMENTS - Dave Blake

He explained test facility and test specimen set-up and described tests conducted at FAA Technical Center to date (reviewed tests conducted since March 1994 meeting). He reviewed future tests planned.

Member Question: Is there a relationship between the smoke and the temperature?

D. Blake: Not always, no.

A. Gupta: Questioned types of tests required for cargo compartment.

D. Hill: You are not going to be able to have one test for the different types of cargo compartments. We will explain more tomorrow when we discuss the Cargo Compartment Minimum Performance Standard.

S. Hariram (Douglas Aircraft): 250° temperature in ceiling may be conservative.

D. Blake: I disagree.

D. Hill: Look at Class 'C' cargo compartment protection report that Dave Blake wrote.

A. Gupta: Task Group #4 presented a report on likely fires in Class 'C' cargo compartments at the last meeting. Did this Task Group's report have any impact your work? I expected some comments or feedback on this report (from the regulatory authorities, airlines, and manufacturers).

D. Hill: That report went out with the March Minutes Package.

A. Gupta: Did you receive any adverse comments on it?

D. Hill: I did not receive any comments on it either positive or negative. We included extinguishing some type of surface burning because of your group's report.

D. Gann (NIST): What is your target date for wrapping up a test for certification?

D. Hill: It varies with application. The potty bottles is probably the first priority. Our time frame is 5 years. We would like to try to get potty bottles done by the end of the year and possibly handheld extinguishers within two or three years.

WPAFB HALON 1301 REPLACEMENT PROGRAM UPDATE - Mike Bennett

The program is jointly funded by the Navy, Army, Air Force, NIST, FAA, Boeing, and McDonnell Douglas.

He stated that some of the latest detailed data has not be cleared for international release yet. He reviewed the program at WPAFB. He showed a diagram of the engine nacelle test specimen. He stated that by the end of September they should be done with the comparison tests of FM200 and two other agents.

FAA TECHNICAL CENTER HANDHELD EXTINGUISHER PROJECT UPDATE - D. Hill

The FAA Technical Center does not have anyone working on the Handheld Extinguisher Project. However, through the JAA, we have made an arrangement to have: the test method for hidden fires for handheld extinguisher tests done at DLR in Trauen, Germany; and CEAT in Toulouse, France, will work on the toxicity allowable for handheld extinguishers. Unfortunately, representatives from the organizations were unable to attend this meeting.

WORKING GROUP MEMBER PRESENTATIONS

Bill Leach - Naval Air Warfare Center (Warminster, Pennsylvania)

Paul Huston - Paul Huston Associates (Trussville, Alabama)

Elio Guglielmi - North American Fire Guardian (Vancouver, BC, Canada)

WEDNESDAY, JULY 27, 1994

REVIEW OF "CARGO COMPARTMENT HALON REPLACEMENT AGENT/SYSTEM PROPOSED MINIMUM PERFORMANCE STANDARDS" - D. Hill

Opening Statement: O.K. - no comments.

P. Huston: (a) U.L. is not a standards organization. A. Gupta (Boeing): FM and NFPA are also not standards organizations. B. Tapscott (NMERI): You want the agent "listed for use" not "approved" by the organizations.

D. Hill Comment: As an authority, it was our assumption that the less regulations, the better. These are the minimum standards set by the FAA, if OSHA sets less stringent standards, you still have to meet these minimum FAA Performance Standards.

D. Moore (DuPont): FM and U.L. list systems not agents, so they are not meaningful in this document.

D. Hill: We want to make sure that whatever agent is used has already gone through all the rigorous testing so that it can be used in a system, but we don't want to go through that testing. We want to make this to be general enough to cover international use.

P. Huston: Gave example of NFPA standard language.

A. Gupta (Boeing): NFPA does not approve anything. Maybe wording something like this: 'an agent generally accepted for intended use' should be used.

D. Gann (NIST): Why not say SNAP approval, for example?

D. Hill: We will change wording to something like this: 'approved through SNAP approval or equivalent approval' or 'listed by whatever organizations', or 'approved by an international organization acceptable to the authorities'.

Member Comment: Drop the word "major".

D. Gann (NIST): Section (b) (1): When you start looking at pool fires and you go up in size, you reach a point where the burning rate and suppression does not change when you increase the size. I think the rules state that everything has to be referred to in metric measurements.

D. Hill: Each of these will specify the test method once we have developed the test methods.

Section (b) (1): Use 'extinguishing' here and move 'suppressing and controlling' to another section of this Minimum Performance Standard. Replace 'liquid' with something like 'Plexiglas'.

A. Gupta (Boeing): Change 'simulated flight conditions' to 'simulated airflow conditions'.

D. Hill: We will change the fire load to a "Type A" material which will be more repeatable.

S. Hariram (Douglas Aircraft): Section (b) (2): Put a third statement in there. Add a 'C'.

A. Gupta (Boeing): How many tests will be required for a multipurpose compartment? How about 37?

D. Hill: If you added them up correctly, then it is 37. These represent the likely worst case scenario.

Section (B): Add the word 'likely' before 'worst case scenario'.

Member Question: Section (ii): What about airflow and temperature?

Section (3): Size of aerosol can will be outlined in the Test Method.

D. Gann (NIST): Once the can ruptures, about how long does it burn?

D. Hill: The can explodes, it does not burn that long. The reports on aerosol can testing can be requested by contacting April Horner at 609-485-4471 or by fax at 609-485-5796.

D. Gann (NIST): Section (4) (i-ii): This is a good performance criteria, but the reproducibility of the tests may not be 10% depending on the number of tests being done with halon and replacement agents.

Section (5): We are comparing it to what we get for Halon 1301.

Member Question: What toxicity are you referring to?

D. Hill: This covers all toxicity. Toxicity from combustion products and toxicity from decomposition.

D. Gann (NIST): The concept is great, however, suppose there is a leakage between compartments. The toxicity level in the passenger compartment could be sub-toxic.

D. Hill: If you come up with thoughts or suggestions on this standard, send them to us for consideration and discussion or bring them up at the next meeting.

D. Moore (DuPont): What temperature or temperature range do we have to demonstrate this performance at?

D. Hill: The ambient temperature.

TASK GROUP DISCUSSION/ASSIGNMENTS

D. Hill: What new Task Groups should be established and what should current Task Groups be doing?

TASK GROUP #3 - CARGO AREA TEMPERATURE - D. Hill

A. Gupta (Boeing) will compile all information/data as discussed yesterday.

TASK GROUP #5 - ENGINES - M. Kolleck (Booz-Allen & Hamilton)

This Task Group is ongoing. When we receive the report, we will make it available to anyone who wants a copy.

TASK GROUP #6 - CURRENT ALTERNATIVE AGENTS - B. Tapscott (NMERI)

A copy of the DRAFT Task Group Report is included in this package.

B. Tapscott: By the November meeting this group will select the top agents in each category.

D. Gann (NIST): Feels it's unfair to put the burden of the decision on this Task Group.

D. Hill: Maybe you should talk to Bob Tapscott and his group. If they feel that they cannot come up with agents to recommend, then we will take that as their advice.

TASK GROUP #7 - POTTY BOTTLES - B. Glaser (Walter-Kidde)

D. Hill: The draft test method has been written. Bob Glaser will incorporate some of the suggestions made at this meeting.

D. Hill to John Petrakis (FAA/ AIR-120): We will put together a Performance Standard/Criteria for your group to review/critique. We will send it out by September 15, 1994, so you can review it before the next meeting.

TASK GROUP #8 - HALON RESTRICTIONS

D. Hill: Is there any need for more information on the environmental restrictions? Are there specific questions?

Member Suggestion: An explanation of what is going on should be sent around to members of the Working Group as to what exactly is being done.

D. Hill: The way I see it is: The groups that make up these conventions are not aviation oriented.

J. O'Sullivan (British Airways): That is correct. I believe that in the Basle Convention we have a better position to deal with halon issues.

D. Hill: Maybe you can write something up for the Working Group to be included with the Minutes.

J. O'Sullivan: Hopefully, by the next meeting we will have more details and specifics on what we are doing.

ESTABLISHMENT OF NEW TASK GROUPS

TASK GROUP #9 - SMALL SCALE SCREENING TEST FOR CLASS A MATERIALS - D. Blake

The members of this Task Group are: Dave Blake (FAA Technical Center) will chair group; Al Gupta (Boeing), Jerry McOlgan (Federal Express), Doug Dierdorf (Pacific Scientific), Sham Hariram (Douglas Aircraft), Carol Sue Chun (Douglas Aircraft), Kevin Frid (GEC Marconi), and Bob Glaser (Walter-Kidde).

D. Hill: To Working Group: Would you like to establish any other Task Groups? How about a Task Group for suggestions on the surface burning fuel load or do you just want us (FAA) to pick one?

Conclusion: We (FAA) will discuss it with NIST and others. No need for a Task Group.

Member Question: What about handheld extinguishers?

D. Hill: We have left that up to the JAA for right now. DLR and CEAT will be developing test methods. Hopefully, they will attend the next meeting to outline their plans for the Working Group.

D. Hill: How about in the area of toxicity? We will put forming a Task Group on hold until data is collected. We will have more discussion on this at the next meeting.

TASK GROUP #10 - ENGINE NACELLE

Harry Mehta (Boeing) volunteered to participate in the development of a Minimum Performance Standard for engine nacelles.

D. Hill: Work with Mike Bennett (WPAFB) and see what you can come up with for the November meeting.

UPDATE OF MINIMUM PERFORMANCE STANDARD FOR CARGO COMPARTMENT

D. Hill: We will try to have an update for the November meeting.

A. Gupta (Boeing): Will you define some of the terms used such as: 'worst case scenario', etc.?

D. Hill: Yes, we will include definitions.

A. Gupta (Boeing): In these meetings you give us FAA opinions and views but what about the JAA and other foreign authorities? Are you coordinating with them?

D. Hill: German, French, English, Transport Canada, and the FAA discussed the Cargo Performance Standard and their comments were incorporated before it was sent out to the Working Group.

Member Question: Do you have any concerns about limited or prohibited halon testing at the Technical Center?

D. Hill: We are concerned about the price once we run out of our supply.

T. Hillman (Walter-Kidde): With respect to some of the other Task Groups going on, the lavatory issue looks like it is one that can be closed within the near future. Once the lavatory Task Group has completed its work that will be a significant milestone in the effort to find a replacement for halon. It would, therefore, be good if we could close it by November and move on.

A. Gupta (Boeing): How do you plan on collecting all these standards.

D. Hill: That would be up to John Petrakis. The standards may go into an Advisory Circular (A/C). Maybe the Test Methods would go into a format similar to the Aircraft Materials Fire Test Handbook.

NOTE: As noted by Tom Hillman of Walter-Kidde in a fax to Mike Bennett --in response to questions on hydraulic fluid: "With respect to the question which Tom Peacock asked you last week regarding how 83282 compares with Skydrol, the following is offered:

	Auto-Ign. Temp.	Hot Surface Stream	Ign Time Spray
83282	656°F	630°-1080°F	1250°F
Skydrol	950°F	1440°F	1500°F
5606	461°F	730-960°F	1330°F

Conclusion: 83282 is the worst-case hydraulic fluid with respect to surface ignition."

NEXT MEETING

Please see cover letter for specifics on location of the next meeting. The dates are Tuesday and Wednesday, November 15-16, 1994, in the Atlantic City Area.

NOVEMBER 15-16, 1994
MEETING RETURN FORM

INTERNATIONAL HALON REPLACEMENT WORKING GROUP

***NOTE:* YOU WILL NOT RECEIVE MINUTES OF THIS MEETING UNLESS THIS FORM IS RETURNED.**

☐ I will not be able to attend, but please send me the meeting minutes.

The next meeting will be held November 15-16, 1994, at the Trump's Castle Casino-Hotel in Atlantic City, New Jersey. Trump's Castle is located at Huron Avenue & Brigantine Boulevard. Lunch and coffee breaks will be on your own. There are restaurants located in the Hotel.

PLEASE COMPLETE THE FOLLOWING INFORMATION IF YOU PLAN TO ATTEND:

NAME: ______________________________

COMPANY: ______________________________

PHONE: ______________ FAX: ______________

ADDRESS: ______________________________

CITY, STATE, ZIP: ______________________________

COUNTRY: ______________________________

RETURN THIS FORM BY FAX BY FRIDAY, OCTOBER 14, 1994, TO:

APRIL HORNER
FAX: 609-485-5796

OR CALL:

PHONE: 609-485-4471

U.S. Department
of Transportation
Federal Aviation
Administration

IF YOU WOULD LIKE A COPY OF EITHER OF THE REPORTS BELOW, PLEASE CONTACT APRIL HORNER AT 609-485-4471 OR BY FAX AT 609-485-5796 TO REQUEST ONE.

DOT/FAA/CT-89/32

FAA Technical Center
Atlantic City International Airport
N.J. 08405

Fire Hazards of Aerosol Cans in Aircraft Cargo Compartments

David R. Blake

December 1989

Final

This document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161.

US Department of Transportation
Federal Aviation Administration

ANZECC

Australian and New Zealand Environment and Conservation Council

Strategy for Ozone Protection in Australia

REVISION [illegible]

DRAFT
for Public Comment
August 1993

RECENT TESTING

Spectronics Aerosol (SFE) in 2357 cubic foot compartment.

-Partially suppressed fire for approx 17 mins.

-Oxygen level continued to drop during those 17 mins to a concentration of approx. 7 percent

-Ceiling temps. at approx 400 F. with some higher.

-Temps increased to 1200 F. after 17 minutes.

FUTURE TESTING

- Containerized and noncontainerized fire load using Halon 1301

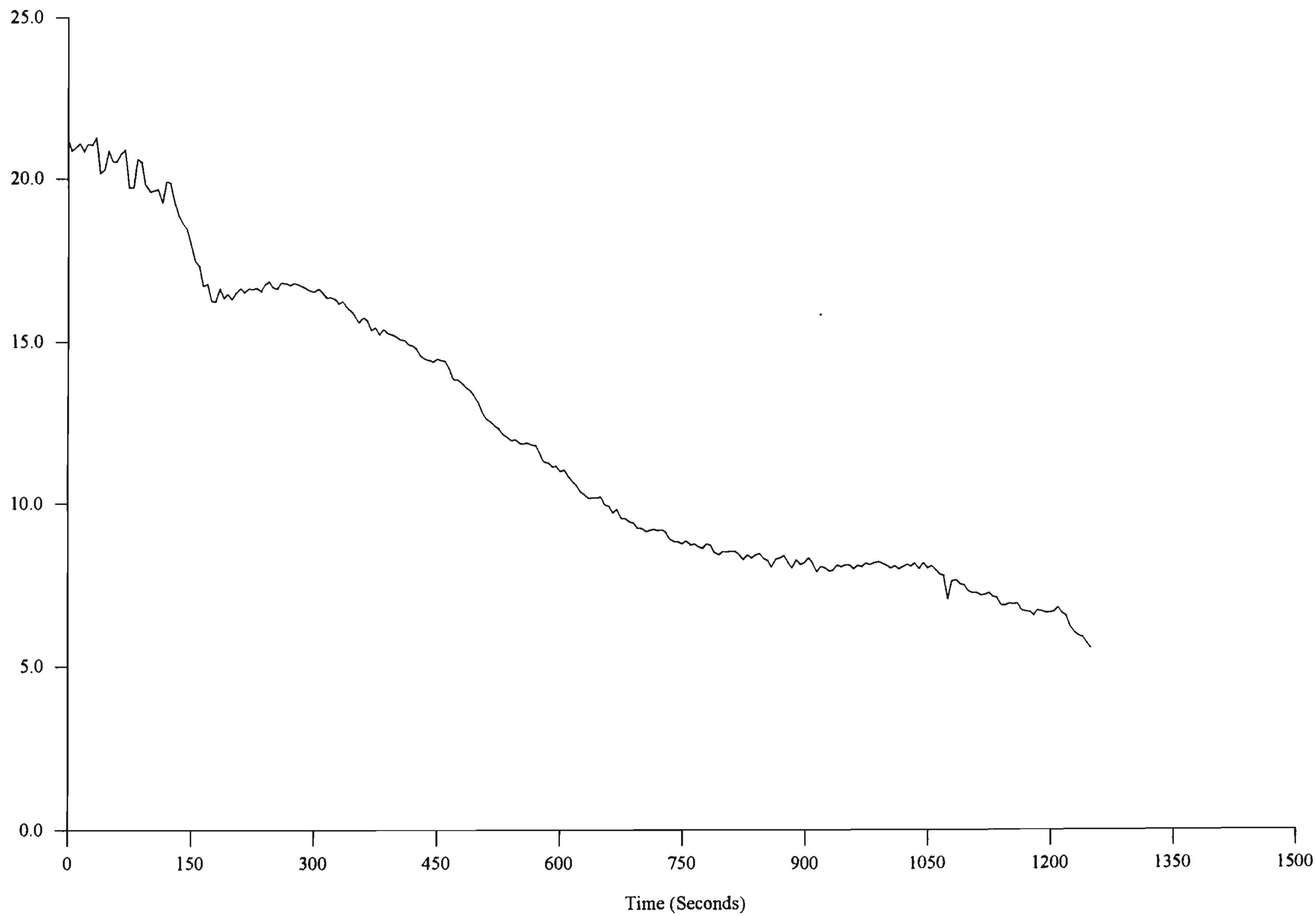
- Containerized and noncontainerized fire load using FM 200

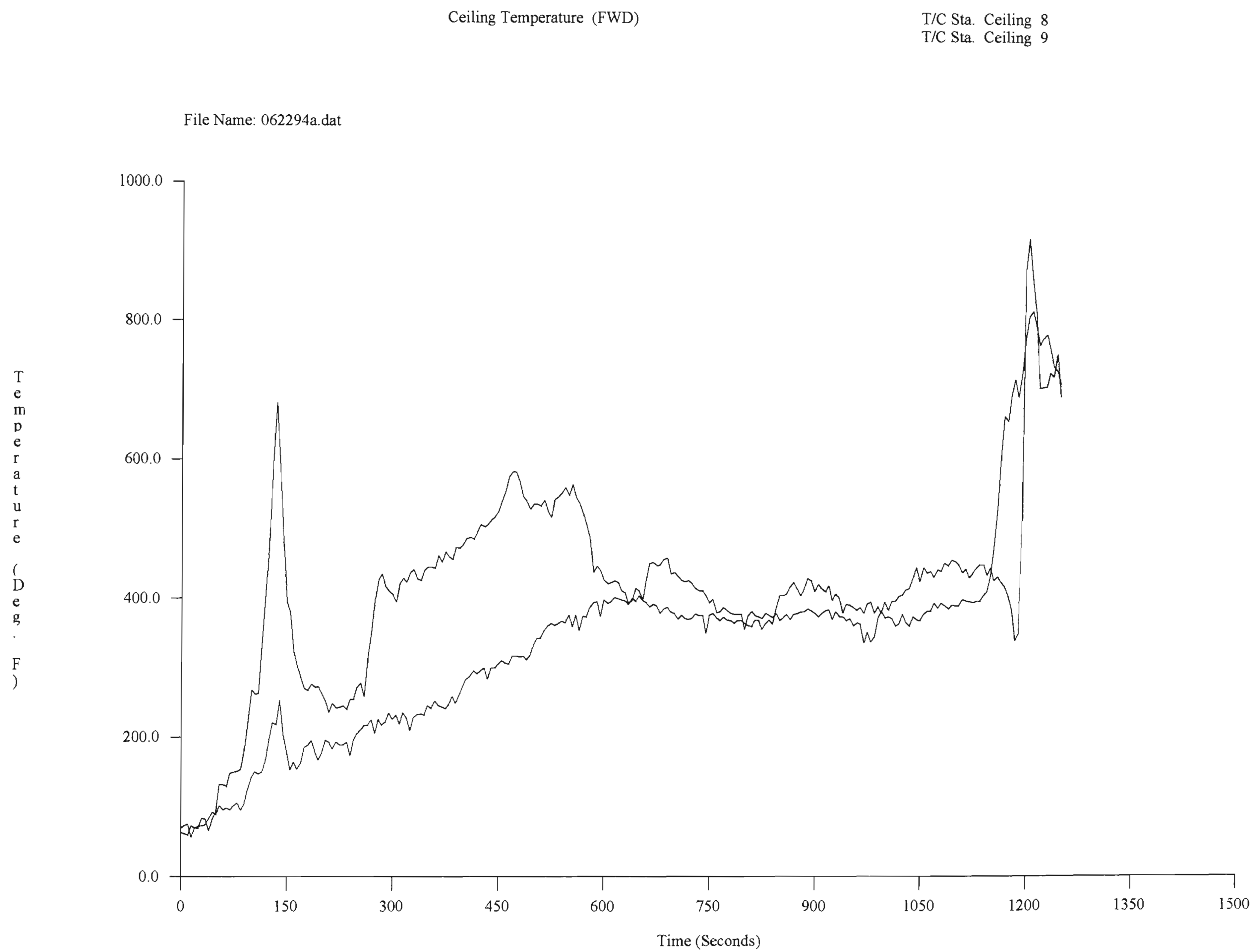
- Baseline tests with containerized and noncontainerized fire loads

Oxygen Profiles

O2 Sta. Cargo Ceiling

File Name: 062294a.dat





Ceiling Temperature (FWD)
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T/C Sta. Ceiling 9
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400.0
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0.0
0
150
300
450
600
750
900
1050
1200
1350
1500
Time (Seconds)

Presentation to
FAA
Seattle, Washington

on Wednesday, July 27, 1994

by

Elio Guglielmi
North American Fire Guardian Technology Inc

Good afternoon ladies and gentlemen I am Elio Guglielmi, President of North American Fire Guardian Technology Inc

I would like to thank the FAA for this opportunity to present information on North American Fire Guardian Technology's fire extinguishing agents -- fire extinguishing agents that have been developed as alternatives to replace the more environmentally damaging halons

I recently received a draft of the FAA's Proposed Minimum Performance Standards for Cargo Compartment Halon Replacement Systems and I would like to complement the FAA on taking the lead Establishing these standards is the first critical step in the evaluation process Aviation associations elsewhere in the world have been floundering and passing the buck, not wanting to be the first to take that big step toward alternative agents

With the FAA gearing up to investigate the various alternatives on the market, and we would very much like to contribute to that process in any way possible

North American Fire Guardian Technology is the manufacturer of environmentally friendly fire extinguishing agents for three distinct types of applications all of which should be of considerable interest to the aviation industry They are

- NAF S-III for total flood systems,
- NAF P-III for hand-held/portable units and
- BLITZ-III for outdoor use where large quantities of product must be delivered from great distances such as by way of a pumping truck

Although each agent has its own appeal the agent that is probably of greatest interest and benefit to the aviation industry because of the money it can save you, is NAF S-III So its probably best I start there

There has been a great deal of rumour speculation and conta[illegible] NAF S-III and I would like to set the record straight

Fact	NAF S-III is the "overall" environmentally sa[illegible] [illegible]ernative on the market today
Fact	NAF S-III is a virtual "drop-in" replacement to Halon 1301 in existing systems
Fact	NAF S-III is the ONLY virtual "drop-in" replacement on the market today
Fact	The cost of switching to NAF S-III is considerably less than refitting costs associated with the other alternatives on the market today

Although the environmental aspect of NAF S-III is very important -- it is after all the reason we are discussing alternative agents in the first place -- I would like to initially discuss the agent's "drop-in" capability

How can we say that NAF S-III is a virtual "drop-in" replacement to Halon 1301? Because NAF S-III can be used in existing Halon 1301 systems with only minor modifications But before I get into what modifications may be needed, let me explain why NAF S-III can be used in an existing Halon 1301 system

Firstly, by weight, only 10% more NAF S-III than Halon 1301 is required, which has been confirmed by Underwriters' Laboratories in Canada What this means is that per cubic foot, 0 0226 pounds of NAF S-III would be required to put out the same fire as 0 0206 pounds of Halon 1301 An insignificant variance in the scheme of things

Table 1. Weight Requirements

Weight Requirements	NAF S-III	Halon 1301
Imperial (lb/ft³ at sea level) Metric (g/m³ at sea level)	0 0226 360	0 0206 331

The most common error made when reviewing the "drop-in" capabilities of the product relates to its design concentration The first reaction when comparing the 8 6% of NAF S-III to the 5% concentration of Halon 1301 is to immediately jump to the conclusion that almost 75% more NAF S-III than Halon 1301 would be required to put out the same fire In fact, that is not the case because it is weight, and not design concentration, that determines NAF's "drop-in" capability

NAF S-III's molecular weight is significantly lower than that of Halon 1301 (92 9 versus 148 93 for Halon 1301) It is the differences between concentrations and weight which have a balancing effect The end result it is possible to propel an 8 6% concentration of NAF S-III through the same piping system as a 5% concentration of Halon 1301 This is critical because as you know [illegible] piping system that is the most complex and expensive portion of any total flood system

Table 2. Design Concentration

Design Concentration (*ULC Recognized*)	NAF S-III	Halon 1301
Extinguishing Concentration Design Concentration	7 2% 8 6%	4 1% 5%

There are certain minor modifications, however that may be required The most certain of these relate to the system nozzles In addition, as after a discharge of a halon system hydro static testing should be done and seals and O-rings changed

When it hits the nozzle, NAF S-III is more liquid than Halon 1301 Thus, a different nozzle must be used to get proper coverage and, as with any overhaul of a system, the O-rings and seals must be replaced when switching from Halon 1301 to NAF S-III. Those that are compatible with NAF S-III have already achieved ULC Listing and are readily available

Generally, the storage container of a system can be refilled with the new NAF S-III agent In some cases, however, it will be necessary to use a slightly larger container The factor that will determine this is the fill density of the existing container If the fill density is already maxed out using Halon 1301, then it will be necessary to install a slightly larger container that will allow the mix of NAF S-III and nitrogen needed to propel NAF S-III through the system

Table 3. Fill Density

Fill Density	NAF S-III	Halon 1301
Maximum Fill Density (kg/L)	0 9	1 12

I hope I have been able to clear up any confusion regarding NAF S-III's drop-in capabilities

Although the agent has not yet been installed in an airplane it has been installed in hundreds of locations worldwide -- using both new and used equipment There's the European Economic Community Building, Texaco and Brussels Airport in Belgium, BHP in Australia, National Telephone and the Bank of Santander in Spain, Pirelli and the National Library of Geneva in Italy, and Minolta and BBC in England, to mention only a few

The Supreme Headquarters of the Allied Powers in Europe of NATO has recently made NAF S-III its alternative of choice Beyond the obvious environmental concerns, space and volume were key issues in their evaluation of halon substitutes However, more often it is the cost of changing over to an environmentally friendlier agent that is of upper most importance to the end user

Converting to NAF S-III means that costly refitting charges that are associated with the other alternatives on the market today, can be avoided An excellent example of what this means in practical terms is the study recently undertaken by the Italian National Electric Company They took an existing Halon installation and determined what it would cost to replace that system with several of the alternatives available In determining the total cost, they considered additional equipment that would be needed and the cost of labour The alternatives evaluated were NAF S-III, Inergen and FM 200 In the case of both Inergen and FM 200 a total refitting was required Their findings the cost of switching to Inergen was $107,500 and $82,500 to switch to FM 200 In the case of NAF S-III, only minor modifications to the existing system were required, and the total cost ended up being only $6,280 These figures do not include engineering costs, which were between $15,000 and $20,000, or the cost of product, which together would have increased the variance further (The evaluation is available upon request)

This is, of course, not the only independent evaluation that was done Companies in other countries, including Spain, England, Ireland and Australia, have undertaken similar studies with the same outcome -- NAF S-III is the most cost-effective alternative for current halon users You too would come to the same conclusion if you were to undertake a similar evaluation

As you can see by the evaluations of NATO and the Electric Company, the fact that there are several different categories of alternatives on the market today can make for a difficult evaluation and selection process The complexity of the physical and chemical properties of the available alternatives means that the expertise provided by engineers is more critical now to the process than ever before As you know, a delicate balance must be achieved between chemical composition, equipment and engineering know-how

Although "drop-in" capability has not been listed in the FAA's Proposed Minimum Performance Standards document for cargo compartment halon replacement systems, cost of switching to a safer alternative must be uppermost in your minds, given the space and weight limitations on board aircraft NAF S-III would certainly be the most cost-effective solution and, with a distribution network spanning the globe supply of the agent along your flight patterns would not be a problem

The concerns that are listed in the draft standards document relate primarily to efficacy regulatory approvals, and aircraft operations as it relates to the safety of humans and animals

Although NAF S-III has not yet been tested under simulated flight conditions certain information is already available on the product that would assist you in your initial evaluation of the product other than from an economic standpoint

1 REGULATORY APPROVALS

The FAA has indicated that it will require that an agent be approved by a major national or international standards organization.

NAF S-III has been accepted as an alternative to Halon 1301 for normally OCCUPIED areas by both Environment Canada, and the United States Environmental Protection Agency under its SNAP program In addition, NAF S-III has been included in the recently published NFPA 2001 Standard on Clean Agent Fire Extinguishing Systems Outside of North American, NAF S-III has been approved for use in numerous countries, including as Australia, Bahrain, Belgium, Hong Kong, Italy, Malaysia, Portugal, Saudi Arabia, Singapore Spain and Taiwan Several others are pending

NAF S-III (also known as HCFC Blend A) has proven to be an effective fire suppressing agent under UL 1058 testing procedures Pre-engineered systems using NAF S-III have already achieved both ULC and SASO listings In addition, the agent itself, as well as the computer program developed for it, have achieved listing under ULC's Component Recognition Programme

2 AGENT PERFORMANCE

The FAA has asked that the effectiveness of an agent be tested under simulated flight conditions.

As previously mentioned, NAF S-III has not yet been tested under simulated flight conditions It has, however, been tested under extreme conditions including high ground altitudes, so we have a fair amount of test information available to us

Basically, NAF S-III performs similar to Halon 1301 Like Halon 1301, NAF S-III has been designed to protect hazards that are within well-sealed, fixed enclosures It has been designed to fight Class A, B and C fires, as defined by the NFPA

In the case of deep seated or smouldering fires, as with Halon 1301 high concentrations of NAF S-III would be required in order to control the fire and greatly reduce the rate of burning Experiments have been carried on Class "A" fires at a concentration of between 8 6% and 9 2% with successful results

3 HUMAN SAFETY

The FAA is demanding that toxic gas concentrations in occupied areas be equivalent or better than the levels now accepted for use of 5% by volume concentration of Halon 1301.

The components of the agent have undergone extensive chronic toxicity testing under the PAFTT program

The toxicity level of NAF S-III at an 8 6% design concentration is 6[illegible] ppm for [illegible] minutes versus 8[illegible] for Halon 1301 at 5% This level according to OSHA in the [illegible] and WHMIS in Canada means that NAF S-III is safe for use in normally occupied areas

Regarding cardiac sensitivity, to date NAF S-III has been tested to a concentration of 10%, with no observed adverse effect level (NOAEL)

4 EQUIPMENT SAFETY

The FAA's draft standards expressed an concern than an agent not create a hazard to aircraft operations, including flight safety.

In addition, to being environmentally friendly, NAF S-III is electrically non-conductive and will not damage electronic equipment

It has been proven to be stable as evidenced by the original NAF blends after five years in storage

Who would have thought 10 to 15 years ago that we would be is this dilemma scrambling to find a safe and effective alternative to halon Way back then we thought halons were the ultimate fire fighting agents and that they would be around forever Who would have guessed that these life-saving compounds would be a partially responsible for bringing us to the brink of an environmental disaster

Even with the current global schedule to eliminate ozone-destroying substances, the ozone layer will not return to so-called "normal" for many years to come, if ever Once in the stratosphere some chemicals can last for many decades and, thus, stratospheric chlorine levels may not even begin to decline until the 21st century

There has been concern raised from several quarters regarding the fact that, although low our NAF fire extinguishing agents do have ozone depletion potentials The rumblings in the industry that products with other than a zero ODP value will not have a life beyond 1995 has hurt us in certain parts of the world But we are confident that cool heads will ultimately prevail The United States Environmental Protection Agency and Environment Canada have already clearly stated that they are sticking to the Montreal Protocol guidelines which gives our products a life to at least 2020 To put this into proper perspective, a lifetime to 2020 gives our NAF agents longer lives than the halon's they are intended to replace

But ozone-depletion is proving to be only the tip of the iceberg There are far greater uncertainties associated with global warming It is thought that there will be very significant shifts in climate - storms will become more severe, rainfall will decrease in some areas and increase in others, winters may actually become colder as the summers become hotter But, the biggest uncertainty of all is that, unlike ozone depletion, the damage caused to global climate may not be reversible

As a result, the attention of leading environmentalists and government agencies such as the EPA is moving quickly towards global warming and atmospheric lifetime [illegible] paper released by President Clinton and Vice-President G[illegible] probably already aware the EPA has already moved to restrict the use of certain substances that have in their opinion unacceptable GWP and lifetimes in the atmosphere

The EPA has made it very clear that they are looking at the "overall" impact of alternative products, environmental and otherwise. That includes ozone depletion, atmospheric lifetime, global warming, toxicity and cardiac sensitization. What NAF agents lack on the ODP side, they more than make up for in the other four areas

Although all of the alternatives on the market today are effective fire suppressing agents, none, including our own agents can be deemed "perfect". What I mean by perfect is not only an agent that is an effective fire suppressant, but one which has

- no ozone depletion potential
- no global warming potential
- no lifetime in the atmosphere
- no residue
- no electrical conductivity
- no metal corrosion and
- is compatible with equipment materials
- stable
- and non-toxic

We must accept the fact that every product on the market today falls short of the ideal in one way or another. It either has an ozone depletion potential, a global warming potential, a atmospheric lifetime or is toxic. Thus, while the search for the "perfect" product goes on we are forced to embrace what can only be termed "transitional" products because of their imperfections

From an environmental point of view, the leading transitional product for total flood systems is our NAF S-III agent. It is "overall" the environmentally safest alternative on the market today. What I mean by this is that when taking into account all environmental issues, NAF S-III leads the pack. Firstly, it has a very low ozone depletion potential 0 044 compared to the 16 for Halon 1301

NAF S-III is a blend of HCFCs and when you compare the impact on the environment of HCFCS versus halons, it becomes very clear how important transitional compounds like HCFCs are .

Even with the ban on production of halons they will continue to do considerable damage to the ozone layer for many years to come. Firstly, stockpiled halons will continue to be used in existing systems. Secondly, halons that are not destroyed will remain in storage, continuing to leak into our environment at the rate of about 2% per year. (In some transport applications, where there is considerable vibration, leakages of 15% per year, or greater, are not uncommon.)

Imagine two identical size installations — one using NAF S-III and one using halon

It would take 1 1 tonnes of NAF S-III to replace one tonne of Halon 1301. Based on the conservative leakage rate of 2%, 0 02 tonnes of Halon 1301 and 0 022 tonnes of NAF S-III would leak from that system in a one year period. Based on ODP values of 16 for Halon 1301 and 0 044 for NAF S-III (or weighted 0 048), the ODP value of the leaked product would be 0 32 for Halon 1301 and only 0 0009 for NAF S-III

As you will note, the 0 32 leakage value of one tonne of Halon 1301 is almost eight times the 0 048 value that would result from a complete discharge of the NAF S-III system

The significance of this is obvious, and yet we continue to delay moving to safer products

By the way, as with Halon 1301, the small amount of leakage in no way effects the efficacy of the product in putting out the fire

In addition, it has acceptable toxicity and cardiac sensitization levels

But more importantly, NAF S-III has a very low global warming potential - 0 1 compared to 0 82 for Halon 1301 - and a short atmospheric lifetime - 7 years compared to 107 years for Halon 1301

In addition, to being environmentally friendly, NAF S-III is a clean, non-conductive, non-corrosive agent and is compatible with materials used in current equipment, such as plastic and rubber seals. It has been proven to be stable as evidenced by the fact that after five years, the original NAF blends are still stable

Finally, NAF S-III has acceptable toxicity and cardiac sensitization levels

As previously mentioned, in addition to NAF S-III for total flood systems, we also offer a product for hand-held/portable units, called NAF P-III, and BLITZ-III for outdoor use where large quantities of product must be delivered from great distances by way of helicopter drop or large wheeled extinguishers or mechanical pumps

Like NAF S-III, NAF P-III and BLITZ-III have proven to be effective fire suppressing agents. As new blends, these formulae have not yet gone through UL testing and listing. However, in our own testing programs they have proven to be as effective as prior generations and we are confident that listings will be achieved without any difficulty

Like all NAF fire extinguishing formulas, NAF P-III and BLITZ-III have low ozone depletion and global warming potentials (0 017 and 0 068, respectively) as well as relatively short atmospheric lifetimes (under 2 years for BLITZ-III and 4 years for NAF P-III)

Although NAF P-III is a relatively new product its predecessors have been around for some years and it is believed that the modifications in the formula to make it more environmentally friendly will not adversely effect issues such as electrical conductivity, metal corrosion or the stability of the agent

And like NAF S-III, NAF P-III has been developed for use in existing extinguishers, this will require some minor modifications

In summary how do NAF agents stack up?

Well

- NAF agents are proven effective fire suppressing agents
- NAF agents are overall, the environmentally safest alternatives to Halon 1211 and 1301 on the market today with low ODP and GWP values, short atmospheric lifetimes, and low toxicity and cardiac sensitization levels.
- NAF agents are clean and non-corrosive,
- NAF agents are non-conductive and stable,
- NAF agents are compatible with the halons they are intended to replace, and
- NAF agents are available worldwide through a well-established network of distributors

But, what makes NAF agents unique are their virtual "drop-in" capabilities. This capability, when compared to other alternatives on the market today, puts us ahead of the pack. With NAF agents, you will not only save valuable space on your aircraft but money as well

If you have any questions regarding our products I would be happy to entertain them now

INTERNATIO HALON REPLACEMENT WORKING GROUP

TASK GROUP #7

"POTTY BOTTLES"

FINDINGS & RECOMMENDATIONS

REPORTED ON JULY 26, 1994
RED LION HOTEL
SEATTLE, WASHINGTON

BY
R. E. GLASER

- FIRE FUEL LOAD
  - A/C 25-17 (MIXED TRASH)
  - SHREDDED NEWSPAPER
  - CRUMPLED PAPER HAND TOWELS
- PREPARED RECOMMENDED TEST PROCEDURE FOR CONSIDERATION & APPROVAL

) FUEL LOAD TYPE & QTY

- FAA A/C 25-17
  - (8) PAPER TOWELS
  - (5) PAPER NAPKINS
  - (4) PAPER HOT CUPS
  - (2) PAPER COLD CUPS
  - (1) EMPTY CIGARETTE PACK
    - DICK HILL OF FAA VOICED CONCERN THAT THE MIXTURE MIGHT NOT YIELD CONSISTENT RESULTS.
- SHREDDED PAPER
  - PROVED TO PRESENT AN UNREASONABLY DIFFICULT FIRE CHALLENGE
    - EXISTING LAVEX FAILED TO EXTINGUISH
    - COMPACT NATURE & RESULTING DEEP SEATED FIRE
      - LONG PRE-BURN TIMES AND LARGE INVOLVED SURFACE AREA
      - DIFFICULT TO ACHIEVE AGENT PENETRATION

TASK GROUP CHARTER:

PREPARE RECOMMENDATIONS FOR TESTING ALTERNATIVE AGENTS, FOR USE IN LAVATORY FIRE EXTINGUISHERS, TO DEMONSTRATE EQUIVALENT PERFORMANCE.

TASK GROUP #7 MEMBERSHIP

BOB GLASER - WALTER KIDDE AEROSPACE - CHAIRMAN

ALANKAR GUPTA - BOEING COMMERCIAL AIRPLANE GROUP

CAPT. BOB TETLA - USAF - TYNDALL AFB

SHAM HARIRAM - DOUGLAS AIRCRAFT COMPANY

ISSUES CONSIDERED BY GROUP

A) SIMULATED TRASH RECEPTACLE CONFIGURATION

- AGREED THAT 18"L X 16"H X 8"W CONFIGURATION WAS AN ACCEPTABLE STANDARD (SEE ATTACHMENT FOR DETAILS)
- IGNITION TECHNIQUE AND TEMPERATURE PROBE LOCATIONS WERE ALSO DEFINED
- SPECIFIC TEST PROCEDURE WAS DOCUMENTED:
  - LOAD FUEL INTO FIXTURE
  - INSTALL COLD LAVEX
  - ENERGIZE IGNITER WHEN LAVEX REACHES TBD TEMPERATURE
  - CLOSE VENTS WHEN EXTINGUISHER DISCHARGES
  - OPEN FIXTURE 5 MINUTES AFTER DISCHARGE
  - MONITOR FUEL LOAD FOR 2 ADDITIONAL MINUTES THEN REMOVE AND INSPECT FOR SMOLDERING EMBERS

SUBGROUP ACTIVIT REPORT

- MEETING HELD AT WALTER KIDDE AEROSPACE WILSON, NORTH CAROLINA JUNE 27 & 28, 1994
- ATTENDED BY:
  - WKA (6)
  - FAA
  - BOEING
  - USAF
  - AIRBUS (2)
  - GLCC
- CONDUCTED A SERIES OF 12 FIRE TESTS
  - AGENTS
    - HALON 1301
    - FM-200

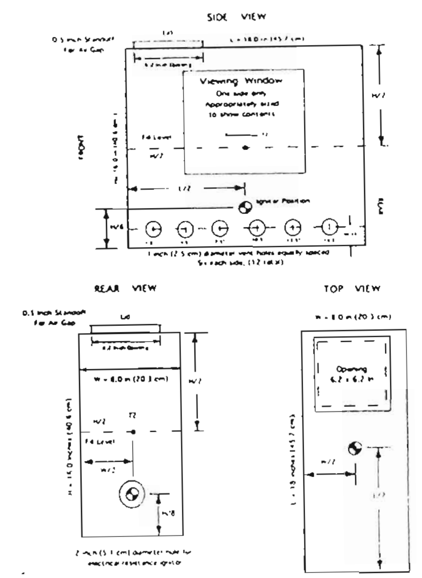

Figure 1: Standard Lavatory Disposal Receptacle For Evaluating Fire Extinguishing Agents

- CRUMBLED PAPER HAND TOWELS
  - ♦ HOMOGENEOUS FIRE LOAD
  - ♦ REPRESENTATIVE TYPE FUEL
  - ♦ TESTS BRACKETED THRESHOLD
    - 938g FAILED TO EXTINGUISH
    - 814g LOAD REPEATABLY SUCCESSFUL EXTINGUISHMENTS

  TASK GROUP #7 RECOMMENDS USE OF 814g AS FIRE LOAD STANDARD

  PAPER TOWELS PER AC 25-17 2 PLY APPROX 10" X 11"

C) PASS/FAIL CRITERIA

- FLAMES OUT FOLLOWING AGENT DISCHARGE
- NO EVIDENCE OF CONTINUING COMBUSTION OR RE-IGNITION
- REPEATABLE PERFORMANCE (4 X MININUM)

D) EXTINGUISHER TEMPERATURE DURING FIRE TEST

- NEW O - ODP AGENTS HAVE HIGHER BOILING POINT THAN HALON 1301
- WASTE RECEPTACLE FIRE UNLIKELY ON EMPTY AIRCRAFT
- PASSENGERS ARE NOT LOADED UNTIL AVERAGE BULK TEMPERATURE APPROXIMATELY 70°F
- WKA's POTTY BOTTLE RISES FROM -65°F TO +40°F IN APPROXIMATELY 25 MINUTES IN STILL AIR @ 70°F
- OEM's WILL NEED TO SELECT AN APPROPRIATE MINIMUM OPERATING TEMPERATURE FOR EACH APPLICATION.

POTTY BOTTLE CONFERENCE
ATTENDANCE LIST

NAME	COMPANY/FACILITY	TELEPHONE NO
Gus Ahlberg	Kidde Technologies Intl. - West	(415) 692-7892
Bob Glaser	Walter Kidde Aerospace	(919) 237-3787 ext 230
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Greg Grimstad	Boeing	(206) 234-1366
George Harrison	Walter Kidde Aerospace	(919) 237-3787 ext 296
Tom Hillman	Kidde Technologies Intl	(404) 751-0835
Doug Ingerson	FAA Tech. Center	(609) 485-7354
Joe Jarrell	Walter Kidde Aerospace	(919) 237-7004
Theo Klems	Airbus Industrie	011 336 193 4905
Mark Robin	Great Lakes	(317) 497-6360
Richard Sears	Walter Kidde Aerospace	(919) 237-3787 ext 287
Bob Tetla	USAF Tyndall	(904) 283-3745 ext 34

Proposed Methodology for Lavatory Disposal Receptacle Built-in Fire Extinguisher Agent Evaluation

1.0 General Information

US Department of Transport, Federal Aviation Regulation DOT 14CFR 121.308(b) requires that, "After April 29, 1987, no person may operate a passenger carrying transport category airplane unless each lavatory in the airplane is equipped with a built-in fire extinguisher for each disposal receptacle for towels, paper, or waste located within the lavatory. The fire extinguisher must be designed to discharge automatically into each disposal receptacle upon occurrence of a fire in the receptacle."

The disposal receptacles are designed to comply with the requirements contained in FAR Part 25.853 (f) which states, "Each receptacle used for the disposal of flammable waste material must be fully enclosed, constructed of at least fire resistance materials, and must contain fires likely to occur in it under normal use. The ability of the receptacle to contain those fires under all probably conditions of wear, misalignment, and ventilation, expected in service must be demonstrated by test." FAA Advisory Circular 25-17 provides an acceptable method to show compliance with this rule.

Currently all aircraft lavatory disposal receptacle fire extinguishers use Halon as the fire extinguishing agent. Halon production has ceased as of 1 January 1994 due to identification as ozone destroying compounds. As a result, a search for an alternative agent is being conducted. To evaluate the performance of potential agents the definition of a standard test method, receptacle, and fire fuel load is necessary. It is the intent of this document to provide this definition.

This proposed evaluation method was developed by Task Group #7 of the International Halon Working Group. It has been prepared for the use and guidance of those charged with designing, installing, testing, purchasing, or approving an agent for the use in aircraft lavatory disposal receptacle built-in fire extinguishers.

This evaluation is not a qualification or certification method for lavatory disposal receptacle built-in free extinguisher systems. Rather it is a means by which to evaluate the agents which provide an equivalent level of safety. Qualification shall be according to the requirements defined in procurement specifications, while certification will be according to methods acceptable to those authorities having jurisdiction.

The fire suppression capability of an agent depends on several variables: discharge method, fuel density and type, ignition source and location, ventilation, etc. A fire extinguishing agent that quickly knocks out flames, prevents high temperatures and minimizes smoldering are characteristics recognized as being required of an agent.

In addition to the agents fire suppression capability other issues which must be considered but are beyond the scope of this task group are:

Ozone Depletion Potential - ODP should be as low as practical and in accord with currently accepted values.

Global Warming Potential - GWP should be as low as practical and in accord with currently acceptable values.

Toxicity - Agents utilized should be SNAP listed for occupied spaces.

Stability - Long term stability say of at least 20 years within the storage vessel is recommended.

Compatibility - Agent compatibility with both the extinguishing system and surrounding aircraft structure and systems must be considered.

2.0 Purpose:

Provide test procedures for the evaluation of fire suppression agents that will insure an equivalent level of fire suppression capability for use in aircraft lavatory disposal receptacles.

2.1 Apparatus:

(i) Standard lavatory disposal receptacle, see Appendix A.
(ii) Fire extinguisher and installation hardware
(iii) Cold chamber
(iv) Fire load, see Appendix B
(v) Electrical resistance igniter

2.2 Instrumentation

(i) A thermocouple shall be installed on the fire extinguisher surface (T1)
(ii) A thermocouple shall be installed at the center-line of the disposal receptacle.
(iii) A thermocouple shall be placed to measure ambient temperature, (T3)
(iv) Data recorder: strip chart or plotter for recording thermocouple data.
(v) Stop watch
(vi) Both still and video cameras
(vii) Scale

2.3 Ambient conditions:

The test will be performed in a chamber whose ambient is defined by:

Temperature	75±25°F
Relative humidity	To be recorded
Ambient pressure	11.0 to 15.0 psia.

Comparative tests of different agents shall be performed at essentially the same (±5%) ambient conditions.

3.0 Test Procedure:

3.1 Weight extinguisher, record the value.

While the extinguisher is conditioning do Steps 3.2 and 3.3

3.2 Condition the fire extinguisher in the cold chamber to a temperature of TBD* -20°F for a minimum of 4 hours so the agent is cold soaked.

3.3 (i) Load the test disposal receptacle described in Appendix A with the fuel described in Appendix B.
(ii) Install igniter and secure approximately 1 inch above the ventilation holes of the disposal receptacle at the approximately receptacle center line.

3.4 (i) Check out data acquisition system.
(ii) Set up video camera

3.5 (i) Mount the conditioned extinguisher on the test chamber. The extinguisher should be installed immediately upon removal from the cold chamber to prevent agent temperature increase.

(ii) Photograph the complete installation.

3.6 (i) Record and monitor extinguisher surface temperature (T1).
(ii) When extinguisher surface temperature, T1, reaches TBD* °F.
(a) Start video camera.
(b) Energize the igniter.
(iii) Begin recording of receptacle temperature, thermocouple T2.

* The minimum operating temperature requirement for the lavatory fire extinguisher is dependent upon the application and thus shall be specified by the aircraft manufacturer.

3.7 Upon agent discharge the following must be performed:

(i) De-energize the igniter.

(ii) Close all ventilation holes

(iii) Five minutes after discharge open the front panel, (assuming no fire or evidence of combustion using both visual and thermal measurements).

(iv) Observe disposal receptacle contents for an additional two minutes for re-ignition.

(a) If the fire does **not** re-ignite. Empty the compartment and spread the waste material into a single layer. Record observations: extent of fire load consumption by fire, presence or lack of smoldering, etc. Take a still photograph(s) in such a way that the degree of combustion can be assessed. Go to Step 3.8.

(b) If the fire re-ignites, extinguish fire by means of choice. Test was a failure.

(v) Continue recording data until contents are removed in step IV.

3.8 (i) Weigh discharged extinguisher.

(ii) Calculate the weight of discharged agent from the data recorded in 3.1 and 3.7 (ix). Record the weight.

3.9 Repeat steps 3.1 through 3.7 three additional times, for a total of four complete tests. (Note: A single failure of any configuration is considered a failure of that configuration. The only way to continue testing is to change the configuration by: 1) adding extinguishing agent to the bottle, 2) change the extinguishing agent, or 3) change the configuration of the system).

4.0 Evaluation criteria

For the agent to be acceptable the following two criteria **must** be met:

1) The extinguishing agent must extinguish the test fire.

2) Successful extinguishment requires that the receptacle thermocouple temperature, after agent discharge, shows a decreasing trend with no significant sustained high temperature excursions. Further, successful extinguishment requires that the fire does not re-ignite on any of the four (4) tests. This requires that the fire not flare-up after the access panel has been opened.

5.0 Test report

The report should contain the data required in Section 3 and be of sufficient detail to enable a technical person, unfamiliar with the subject, to understand. Photographs and video should be included where required and if otherwise appropriate. The report should bear the signatures of the test engineer.

APPENDIX A: DISPOSAL RECEPTACLE AND CHUTE

Figure 1 shows a receptacle acceptable for testing of fire extinguishers for use in disposal receptacles up to 1.333 ft^3 (0.0377 m^3) volume. The test receptacle has a front clear (fire resistant polycarbonate or glass) panel to facilitate visual observations. A 2.0 in (5.1 cm) diameter hole is provided to facilitate insertion of the igniter and shall be sealed after insertion of the igniter. On each side panel are six 1.0 in (2.54 cm) diameter holes (12 holes total) to facilitate air infiltration, these are the holes identified in 3.7(ii) that need to be closed upon discharge of agent.

The waste flap opening will measure 6.20 in (15.7 cm) x 6.20 in (15.7 cm) for a total area of 38.44 in^2 (248 cm^2). A plate mounted 0.5 in (1.27 cm) above this opening will provide 12.4 in^2 for air infiltration.

Maximum open area for air infiltration is 16.4 square inches per cubic foot of receptacle volume. For the test receptacle shown in Figure 1 the maximum infiltration area is 21.8 square inches.

The extinguisher (not shown) shall be installed according to a typical installation drawing.

For comparative evaluation of different systems and/or agents identical receptacles and fire load shall be used. The maximum variation in ambient parameters shall not exceed $\pm 5\%$ of the nominal value.

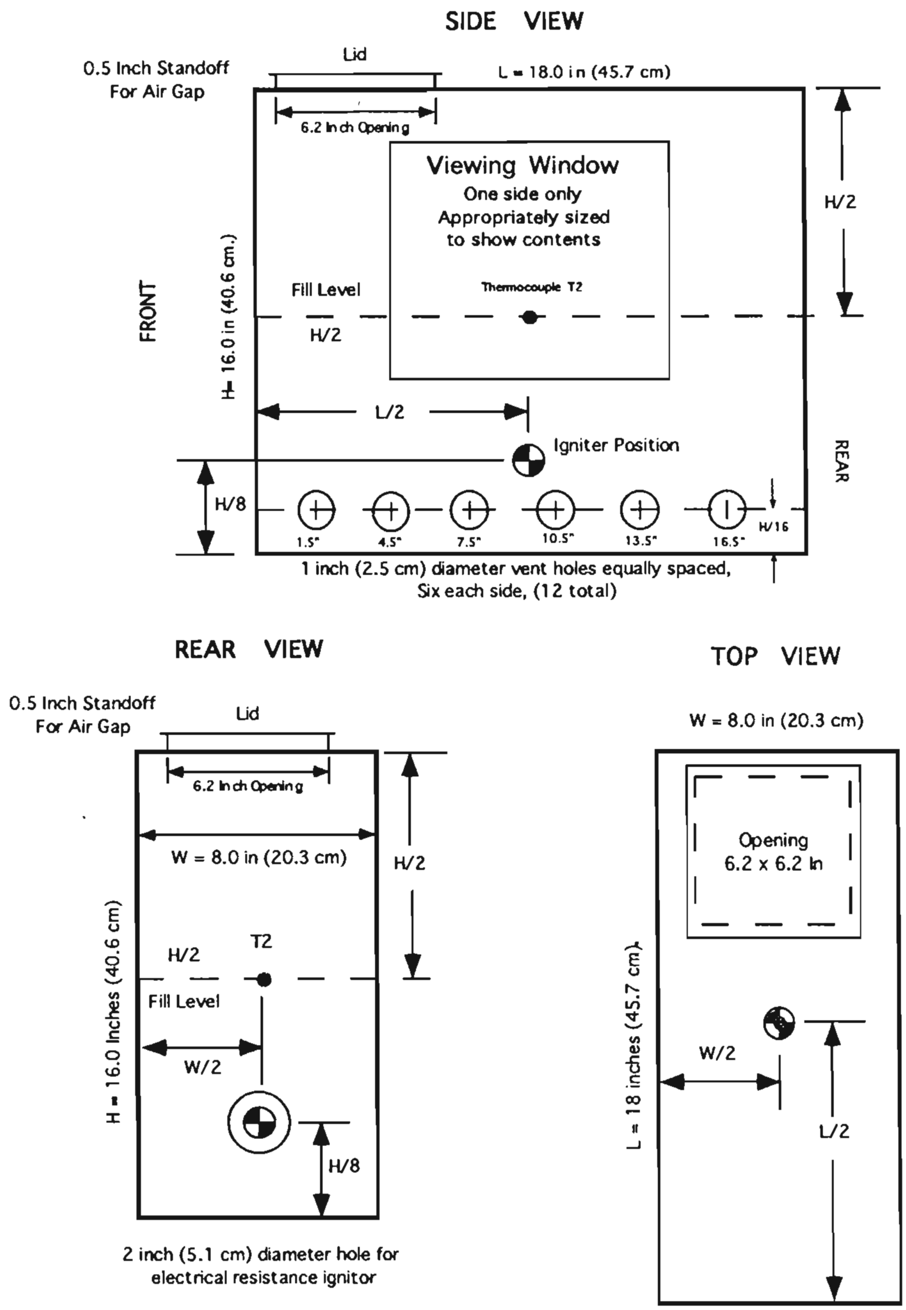

Figure 1: Standard Lavatory Disposal Receptacle For Evaluating Fire Extinguishing Agents

APPENDIX B: FIRE LOAD

The fire load shall consist of the following materials and shall be loaded into the test receptacle (see Appendix A) as follows:

Fire load composition

(i) Paper hand towels, having a total weight of 815 ±5g two ply, approximately 10 x 11.0 in (25.0 x 28.0 cm.) These shall be opened and crumpled to simulate used hand towels.

Note: Fuel load shall be stored in a space which maintains a relative humidity of 45± 15% for a minimum of 72 hrs. to avoid excess moisture content.

Loading sequence

(i) Pack several crumpled hand towels under igniter to prevent damage to same during subsequent loading.

(ii) Load remaining hand towels and compress to 50% fill level. Allow hand towels to spring back to natural level.

DRAFT 30 August 1994

REPORT OF TASK GROUP 6
CHEMICAL OPTIONS TO HALONS

International Halon Replacement Working Group Meeting
26, 27 July 1994
Red Lion Hotel
Seattle, Washington

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INTRODUCTION

The first meeting of the International Halon Replacement Working Group (IHRWG) was held on 13-14 October 1993 at the Federal Aviation Administration (FAA) Technical Center, Atlantic City International Airport, New Jersey, USA. At that meeting, a number of task groups were established. Task Group 6 was assigned a review of "Chemical Options to Halons." A major goal for this Task Group is to recommend two to three agents for use in developing FAA test protocols for each major area of on-board aircraft use: (1) engine nacelles, (2) handheld extinguishers, (3) cargo compartments, and (4) lavatory protection ("potty bottles"). The membership of Task Group 6 is shown below.

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The first draft of this report was presented at the second meeting of the IHRWG at the Fire Service College in Gloucestershire, England. At that meeting, it was decided to include "classical" alternative agents such as standard foams, dry chemicals, and water sprays. Based on these and other comments received, the report was modified and expanded. The following draft report was prepared for presentation at the 3rd meeting of the IHRWG held on 26, 27 July 1994 at the Red Lion Hotel, Seattle, Washington. Some modifications and corrections have been made since that meeting.

Before discussing chemical options to halons, we need some definitions to ensure that we are all talking about the same thing. The term "options" is used for anything that could be used in place of halons. "Replacements" denote fire extinguishants that are chemically similar to the present halons; "alternatives," are everything else. Moreover, replacements are divided into two types — first-generation and second-generation. "Chemical alternatives" are materials such as carbon dioxide, foam, water, and dry chemical whose chemistries differ from those of the halons. "Engineering alternatives" (not covered in this report) involve such approaches as rapid response and fire resistant structures.

Any option to halons must be approved under the EPA's SNAP program, which implements section 612 of the amended Clean Air Act of 1990. The plan for the SNAP program and an initial list of decisions on acceptable and unacceptable halon substitutes were promulgated on 18 March 1994 (Reference 1). A second list of acceptability decisions has now been distributed, but has not yet been published. Substances prohibited, acceptable only under certain conditions or for certain uses, or removed from a list of prohibited or acceptable substitutes are subject to public comment. Other substances for which there are no limitations are listed as acceptable with no public comment required.

REPLACEMENTS

There are a number of desirable characteristics for replacement (e.g., halocarbon) agents. That they must have acceptable global environmental characteristics (e.g., low ozone depletion potentials, ODPs, and low global warming potentials (GWPs) is obvious. The toxicity must also be acceptable, though there may be some debate about what is an acceptable level. The primary reason for using halocarbons, rather than such alternatives as foams and dry chemicals, is that halocarbons are clean and volatile. Finally, the agent must be effective. Note, however, that effectiveness does not necessarily mean as effective as the present halons, though this is desirable.

The terms "first-generation" and "second-generation" were introduced at the first Halon Alternatives Technical Working Conference held in Albuquerque in 1991. The refrigeration industry has now adopted these terms for refrigerant replacements, though that sector uses three categories: first-generation refrigerant replacements (primarily HCFCs), second-generation (HFCs), and third-generation ("natural" refrigerants — carbon dioxide, air, sulfur dioxide, ammonia, etc.).

Before defining first- and second-generation halon replacements, we need to consider two different types of agents. Physical action agents (PAAs) are those that operate primarily by heat absorption. Chemical action agents (CAAs) are those that operate primarily by chemical means — removal of flame free radicals. In general, CAAs are much more effective extinguishants than are PAAs, but PAAs are usually more environmentally benign. CAAs often have high ODPs.

First-generation replacements refer to halocarbon candidates that we have today. Many of those candidates have global environmental, toxicological, or effectiveness drawbacks. They are either (1) CAAs that have high or relatively high ODPs (HBFC-22B1 being the only example) or (2) PAAs. Second-generation agents are proposed candidate agents that equal the halons in effectiveness, but have low tropospheric half lives giving them low global environmental impacts. Thus, second-generation halon replacements are CAAs with low ODPs and GWPs. Many families of chemicals are known with these attributes; however, toxicities and other issues are relatively unknown.

FIRST-GENERATION HALOCARBON REPLACEMENTS

Most of the first-generation agents are PAAs — chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), or perfluorocarbons (FCs or PFCs). The only first-generation CAAs that have been announced are hydrobromofluorocarbons (HBFCs), which have high or relatively high ODPs, and which will be phased out by 1 January 1996 under the Copenhagen amendment to the Montreal Protocol.

A large number of candidate replacement agents have been announced for commercialization, and even more chemicals are under serious consideration. A number of first-generation replacements have been announced for total-flooding applications Table 1. All of these agents are contained in the NFPA 2001 Standard on "Clean Agent Fire Extinguishing Systems"

(Reference 2). The design concentrations are shown in Table 2. This table also provides weight and volume equivalency relative to Halon 1301. Note that the numbers may differ between different sources.

Table 1. Announced First-Generation Total Flood Replacement Agents

Agent	Chemical	Formula	Trade Name
HBFC-22B1	Bromodifluoromethane	CHF_2Br	Great Lakes FM-100™
HCFC-124	Chlorotetrafluoroethane	$CHClFCF_3$	DuPont FE-241
HCFC Blend A Includes			North American Fire Guardian NAF S-III
HCFC-123	Dichlorotrifluoroethane	$CHCl_2CF_3$	
HCFC-22	Chlorodifluoromethane	$CHClF_2$	
HCFC-124	Chlorotetrafluoroethane	$CHClFCF_3$	
HFC-23	Trifluoromethane	CHF_3	DuPont FE-13
HFC-125	Pentafluoroethane	CHF_2CF_3	DuPont FE-25
HFC-227ea	Heptafluoropropane	CF_3CHFCF_3	Great Lakes FM-200™
HFC-236fa	1,1,1,3,3,3-Hexafluoropropane	$CF_3CH_2CF_3$	DuPont FE-36
FC-3-1-10	Perfluorobutane	$CF_3CF_2CF_2CF_3$	3M Company CEA 410

Table 2. Design Concentrations Total Flood Replacement Agents

Agent	Design Conc., %	Volume Equivalent[a]	Weight Equivalant[a]	Maximum Fill Density, lb/ft^3	Storage Pressure, psi
Halon 1301[b]	5	1.0	1.0	70	360
HBFC-22B1	4.9		0.9		
HCFC-124[b]	8.5	1.6	1.6	71	
HCFC Blend A[b]	8.6	1.4	1.1	56	360
HFC-23[b]	16	2.2	1.7	54	609
HFC-125[b]	10.9	2.3	1.9	58	166
HFC-227ea[b]	7	1.6	1.7	72	360
HFC-236fa	5.3				
FC-3-1-10[b]	6	1.7	1.9	80	360

[a]Volume Equivalent is volume of agent required divided by volume of Halon 1301 required; Weight Equivalent is weight of agent required divided by weight of Halon 1301 required.

[b]Information prepared by Halon Alternatives Research Corporation (HARC, Reference 3) for most recent SNAP publication.

Until recently, the number of agents announced for streaming applications was small. Recently, however, the number has increased markedly Table 3.

Table 3. Announced First -Generation Streaming Agents

Agent	Chemical	Formula	Trade Name
HBFC-22B1	Bromodifluoromethane	CHF_2Br	Great Lakes FM-100™
HCFC-123	Dichlorotrifluoroethane	$CHCl_2CF_3$	DuPont FE-232
HCFC-124	Chlorotetrafluoroethane	$CHClFCF_3$	DuPont FE-241
HCFC Blend B Primarily HCFC-123	Dichlorotrifluoroethane	$CHCl_2CF_3$	American Pacific Halotron I
HFC-227ea	Heptafluoropropane	CF_3CHFCF_3	Great Lakes FM-200™
FC-5-1-14	Perfluorohexane	$CF_3(CF_2)_4CF_3$	3M Company CEA 614

All of these first-generation agents have tradeoffs in one way or another. As noted earlier, halon replacements have four desirable characteristics: a low global environmental impact, acceptable toxicity, cleanliness/volatility, and effectiveness. Though it is very easy to find candidate replacements that meet any three of these criteria, it has been difficult to find agents that meet all four. For most (but not all) applications, significantly more replacement agent (except HBFC-22B1, which will be phased out starting 1 January 1996) is needed to provide the same degree of protection as provided by the present halons.

SECOND-GENERATION REPLACEMENTS

Researchers are looking increasingly at "second-generation" agents — materials that are highly effective, yet have low global environmental impacts. It now appears that all such materials must be CAAs. Most of the proposed compounds contain bromine or iodine, both of which are known to give a chemically active halocarbon fire extinguishant. Tropodegradability is an important feature of most of the second-generation chemicals under serious consideration.

Tropodegradable chemicals have features that promote low atmospheric lifetimes, a property that reduces the ODPs and GWPs, in many cases to near zero. Tropodegradability requires processes for atmospheric removal, either by destruction or by rainout. The three major mechanisms for destruction of halocarbons in the troposphere are photolysis, attack by hydroxyl (OH) radicals, and attack by oxygen atoms (O). The sunlight reaching the troposphere has a longer wavelength (and a correspondingly lower energy) than that reaching the stratosphere. If molecules are to be photolyzed in the troposphere they must contain chromophoric (light absorbing) groups, weak bonds, or both. Chromophoric groups include carbon-to-carbon multiple bonds (giving compounds that include the alkenes) and carbon-to-iodine single bonds ("iodides"). The latter type of chemical bonds are also weak compared to other carbon-halogen bonds. Carbon-to-carbon multiple bonds also react rapidly with naturally-occurring OH radicals found in the troposphere. Rainout requires that a compound has sufficient polarity to permit significant water solubility. A number of tropodegradable and polar fire second-generation CAAs have been identified (Reference 4), although no thorough survey has been made. A recent meeting held at the New Mexico Engineering Research Institute (NMERI) in Albuquerque discussed the formation of an Advanced Agent Working Group to further work on second-generation agents (Reference 5). A meeting has also been held at the National Institute of Standards and Technologies to initiate planning of new research directions (Reference 6).

A major problem is that we know little about manufacturability, toxicity, emissions, materials compatibility, and stability, and the market may not be sufficiently large to justify the cost of determining these unknowns. Even more problematical is that recent testing has shown that the most promising of the second-generation agents, CF_3I, has a sufficiently high toxicity that it will probably be unusable for total-flood applications in normally occupied areas (Table 4). On the other hand, CF_3I may very well be useful as a streaming agent, even in occupied areas, and plans for marketing the material under the name Triodide® (Pacific Scientific) are being made. Note that Halon 1211 has a NOAEL of 0.5% and a LOAEL of 1%, and, like CF_3I, could not be used as a total-flood agent in a normally occupied area. Toxicity testing of a second iodide, $C3F_7I$, is now under way.

Table 4. Recent Toxicological Results for CF3I

NOAEL (Cardiac Sensitization)[a]	0.2%
LOAEL (Cardiac Sensitization)[a]	0.4%
Ames Tests:	Positive, 4 out of 5
Mouse Mononucleus (Whole Animal)	Positive
Mouse Lymphoma (Cell Culture)	Negative

[a]NOAEL = No Observed Adverse Effect Level; LOAEL = Lowest Observed Adverse Effect Level.

ALTERNATIVES

More and more, non-halocarbon substitutes are being considered for replacement of halons. Already, water sprinklers are replacing halon systems in many applications. Dry chemical extinguishants and carbon dioxide are also receiving increased use. Alternatives can be divided into two types: "Classical" Alternatives and "Second-Generation" Alternatives (Table 5). Misting and particulate aerosols require decreased amounts of agents that can lead to secondary fire damage. Thus, these technologies may allow protection while minimizing the problems normally associated with water and solids. Recent advances in inert gases may allow the use of inert gas blends in new applications, particularly in occupied areas.

Table 5. Alternatives

Classical	Second-Generation
Water Sprinklers	Misting
Foams	Particulate Aerosols
Dry Chemicals	Inert Gases
	Gas Generators
	Solid/Halocarbon Blends

WATER MISTING

Water misting systems allow the use of fine water sprays to provide fire protection with reduced water requirements and reduced secondary damage. Calculations indicate that on a weight basis, water could provide fire extinguishment capabilities better than those of halons provided that complete or near-complete evaporation of water is achieved. Since small droplets evaporate significantly faster than large droplets, the small droplets achievable through misting systems could provide this capability. No criteria have yet been established on the dividing line between mists and sprays; however, droplet sizes of 100 microns or less are often used as a criterion.

Work on misting systems in the U.S. has been scattered. The need for such work and some concepts have been described at the Water Mist Fire Suppression Workshop, at the National Institute of Standards and Technology on 1-2 March 1993. Some work has been performed by the Fire Research Station in England on non-total-flood applications, primarily aircraft crash/rescue, the Channel Tunnel, and streaming. Water misting has been found to be effective in suppressing flammable liquid fires (Reference 7), and it has been considered for use in spacecraft (Reference 8). The Naval Research Laboratory is examining water misting nozzles to simulate Halon 1211 for firefighter training (Reference 9).

There are two basic types of water mist suppression systems: single and dual fluid systems. Single fluid systems utilize water stored at high pressure (40-200 bar) and spray nozzles which deliver drop sizes in the 10 to 100 μm diameter range. Dual systems use air, nitrous oxide, or other gas to atomize water at a nozzle. Both types of systems have been shown to be promising fire suppression systems. It is more difficult to develop single phase systems with the proper drop size distribution, spray geometry, and momentum characteristics. In addition, dual-fluid systems have a higher spray energy for a given water pressure, are comparatively low pressure system with a maximum air and water pressure in the lines of about 100 psi (single-fluid systems require about 1000 to 3000 psi depending on the nozzle design), and have larger nozzle orifices, which may have greater tolerance to dirt and contaminations to the use of higher viscosity antifreeze mixtures. On the other hand, single-fluid (high-pressure) systems require only storage of water, whereas dual-fluid systems require storage of both water and atomizer gas.

Water mist systems are reasonably weight efficient. The use of small diameter distribution tubing and the possible use of composite, lightweight, high-pressure storage cylinders would increase this efficiency. It may also be possible to integrate a “central storage” of agent for use in several potential fire locations (for example, cargo and passenger cabin locations). This would further increase the benefit.

The major difficulties with water mist systems are those associated with design and engineering. These problems arise from the need to distribute the mist throughout the space while gravity and agent deposition loss on surfaces deplete the concentration. The need to generate, distribute, and maintain an adequate concentration of the proper size drops. Engineering analysis and evaluation if droplet loss and fallout as well as optimum drop size ranges and concentrations can be used effectively to minimize the uncertainty and direct the experimental program.

For aircraft use, misting systems are most appropriately considered for cargo bay and, possibly, engine nacelle applications.

Table 6 gives a list of manufacturers for water misting systems.

Table 6. Commercial and Near-Commercial Misting Systems

Dual Fluid
•ADA Technologies, U.S.A.
•FSI/Kidde Graviner, Kidde Fenwal, UK, U.S.A.
•Ginge Kerr, U.K., Denmark, Norway
•Secuirplex, Canada
•GEC-Marconi Avionics, UK
High Pressure
•Baumac International, U.S.A.
•Semco, U.S.A./Denmark
•Marioff Hi-fog, Finland
•Microguard-Unifog, Germany
•Spraying Systems, U.S.A.
•Bete Fog, U.S.A.

PARTICULATE AEROSOLS

Dry chemicals agents are at least as effective as halons in suppressing fires and explosions in many applications; however, such agents are exceedingly damaging to electronic equipment. Moreover, dry chemical agents, as now used, do not provide the extended inertion (explosion or fire) provided by halon systems. The discharge of dry chemicals also obscures vision. In Geneva Switzerland at the 2nd Conference on the Fire Protecting Halons and the Environment, 1-3 October 1990, representatives of the Soviet Union provided information on a solid agent that they claimed provides relatively long-term (20 minutes or more) inertion of an enclosed volume and excellent fire extinguishment (Reference 10). They have continued to keep the agent and the generation system secret; however, the small amount of information provided indicates that the Soviet material was a very fine particulate generated by combustion. Some have termed this type of technology "pyrotechnically generated aerosols," PGAs.

At the International Symposium on Halon Replacement in Aviation held in Reston, Virginia on 9-10 February 1993, extreme interest in the new pyrotechnically generated aerosol (PGA) technology was expressed. This Technology was also discussed at the 1993 NMERI Halon

Alternatives Technical Working Conference, 11-13 May 1993 in Albuquerque, where three papers on particulate aerosols are scheduled for presentation (References 11, 12, 13).

One of the problems encountered with particulate aerosols is that the technologies are often proprietary or ill-defined. Thus, it is not at all obvious that, for example, the term PGA applies to all of the agents. The following presents some information on these materials.

S.F.E. Extinguishing Agents

The S.F.E. family of extinguishing agents is produced by Spectrex. Their system was recently tested (Reference 14).This new class of fire extinguishing agents known as SFE or EMAA (Encapsulated Micron Aerosol Agents) offer an air suspended dry chemical aerosol with micron size particles, that provide total flood capabilities. Some studies indicate that on a weight basis, the agents are three times more efficient than regular dry powders and five times more efficient than halocarbon extinguishing agents.

The S.F.E. compound in its various forms, upon activation ignites and creates an aerosol that contains about 40 percent solid particles (size of particle less than 1μ) of salts like KCl, K_2CO_3, etc. The remaining 60 percent of the emissions are gaseous combustion products such as CO_2, N_2, H_2O, O_2, and traces (ppm) of hydrocarbons.

The Aerosol solid particles, as a result of the high temperature of combustion, create a large surface area for capturing active species of the fire chain, such as hydroxyl free radicals (OH), which are considered to be the fire chain carriers. The smaller particle size provides for better dispersion and more effective aerosol. As the particle size decreases, the extinguishing surface of the aerosol on which heterogeneous recombination of the chain propagators takes place, increases. Moreover, as the size of the particles diminishes, rate of sublimation increases and the extinguishing effect is augmented by homogenous gas phase inhibition of the fire/flame through the interference of gaseous products forming from the condensed part of the Aerosol. It can be summarized that both heterogeneous inhibition (on the surface of the solid particles) as well as homogenous inhibition (in the gaseous phase) take place in the extinguishing process.

Physical characteristics of the solid compound include:

Specific density	1.6 - 1.8 x 10^3 Kg/m^3
Combustion Temp (°K)	1500 - 2400 °K
Combustion Velocity (mm/sec)	0.3 - 1.5 mm/sec
Shelf Life	15 years
Texture	Solid fine powdered mixture or gelled paste.

INERT GASES

It is becoming increasingly apparent that inert gases may not pose the risks to health that they were once thought to. A number of pure and blended inert gases are now undergoing consideration as alternatives to halons (Table 7).

Table 7. Inert Gases

Designation	Composition	Manufacturer	Use Concentration
IG-541(Inergen)	Nitrogen 52% ± 4% Argon 40% ± 4% CO_2 8|% ± 1	Ansul	35-50%
IG-55(Argonite)	Nitrogen 50% ± 5 Argon 50% ± 5	Securiplex/Ginge Kerr	35-50%
Argon	100% Argon	MiniMax	35-50%
Nitrogen	100% Nitrogen	Cyberus	

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THE BASLE CONVENTION

(Information from J. O'Sullivan)

The Basle Convention has the potential to be a serious impediment to the transshipment of recycled halons, or halons to be recycled, across international boundaries. Whilst the Montreal Protocol allows unrestricted trade in recycled halons between signatories, as described below, the Basle Convention does not. This is further complicated by the fact that not all signatories to the Montreal Protocol are signatories to the Basle Convention, and that technically signatories cannot trade with non-signatories unless a bilateral agreement exists which is no less stringent than the Basle Convention requirements. The following interpretation of the impact of the Basle Convention, and the recommendations to the parties to the Montreal Protocol by the Halons Technical Options Committee, are based upon the best available advice at this time and should not be considered definitive or a legal opinion.

In general, if either party in a trade (exporter or importer) of halon, or country through which a shipment must pass, considers recycled or recyclable halon to be a 'hazardous waste' as determined by their national law, then the trade is covered by the Basle Convention. This means that transshipment of the material is allowed only if an agreement complying with the Basle regime is executed by all parties involved. This will involve notification, consent, and the establishment of sound environmental management of the waste. However, it is likely that if the recovered halon is uncontaminated, or has already been reprocessed to service specification, then it will not be considered a 'hazardous waste', and hence exports of the material would be unaffected by the Basle Convention. For this reason, the Halons Technical Options Committee recommends that the Parties to the Montreal Protocol consider:

a) Adopting a decision that international transfers of halons that cannot meet the purity specifications of ISO 7201 or ASTM ES 24-93 should only be allowed if the recipient country has recycling and reclaiming facilities that can process the received halon to either of these standards.

b) Recommending to the Technical Working Group of the Basle Convention that the Basle Convention adopt a decision that, inter alia, halons that are certified to the usable purity specifications ISO 7201 or ASTM ES 24-93 should not be considered hazardous wastes under the Basle Convention.

The Halons Technical Options Committee believes that this recommendation will achieve the results desired by both the Basle convention and the Montreal Protocol, and will remove the current confusion regarding permitted international trade in recycled halons.

A separate decision of the Basle Convention will ban exports of 'hazardous wastes' from OECD to non-OECD countries after 1997. Again, if the Parties to the Montreal Protocol and the Basle Convention accept recommendations a) and b) above, this will greatly assist non-OECD countries in meeting their needs with recycled halons instead of with new production.

NOTE: THIS IS A DRAFT PROPOSAL TO BE AGREED.