Fire Suppression Systems Association

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FSSA Webinar
Clean Agents 101

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BFPE International

FSSA
Fire Suppression Systems Association

Agenda

- FSSA Overview
- Fire Protection and YOU!
- Clean Agent Options
- Clean Agent System Design
- Your Clean Agent System
- Questions / Answers

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- **FSSA Overview**
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FSSA Overview

What is the Fire Suppression Systems Association (FSSA)?

- Not-for-Profit Trade Association founded in 1982
- Domestic & International members comprised of academics, consultants, designer/installers, manufacturers and suppliers
- Members are specialists in protecting high value special hazard areas from fire.
- Always accepting new members.

FSSA Overview

Mission of Fire Suppression System Association (FSSA)

The FSSA is dedicated to promoting use of, and being the recognized leader on, special hazard fire protection systems; employing existing and new technologies to safeguard people, high-value assets and the environment.

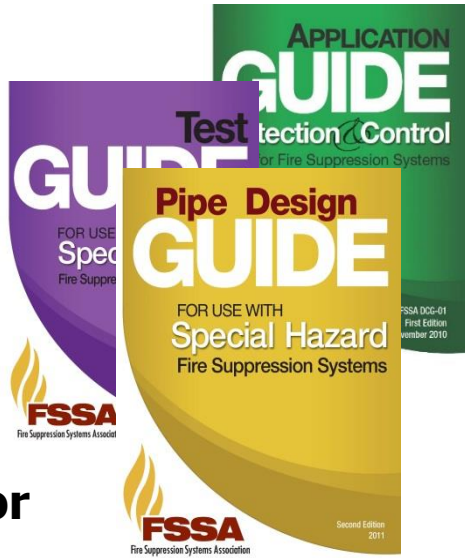
As a global-reaching organization, the FSSA provides our members support and guidance with many questions or issues that arise – with a strong united voice.

FSSA Overview

Support and Guidance

- SHAPE Program – **S**pecial **H**azards **A**wareness **P**romotion & **E**ducation
- Online Training
- Design Guides
- Webinars
- Annual Forum

FSSA
FSSA Training Program



To learn more about the FSSA, visit www.fssa.net or call the FSSA Headquarters at (410) 931-8100

Agenda

- FSSA Overview
- **Fire Protection and YOU!**
- Clean Agent Options
- Clean Agent System Design
- Your Clean Agent System
- Questions / Answers

Fire Protection and YOU!

Considerations

- Irreplaceable Assets
- High-Valued Assets
- Data
- Intellectual Property
- Financial Records
- Environmental Goals
- Clean-Up

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Fire Protection and YOU!

Considerations

- Business Interruption
- Insurance
- Lawsuits
- Collateral Damage
- Injury-Related Claims
- Loss of Customer Confidence
- Downtime

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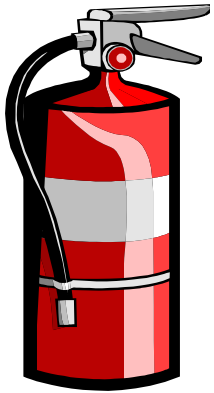
What type of fire protection do you want?

Streaming

Portable Fire Extinguisher



Flooding

Suppression System

Fire Sprinkler

Clean Agent

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What are you protecting?

Structure or **contents** of structure?

Fire Control

Fire Sprinkler System

Fire Extinguishment

Clean Agent Suppression System

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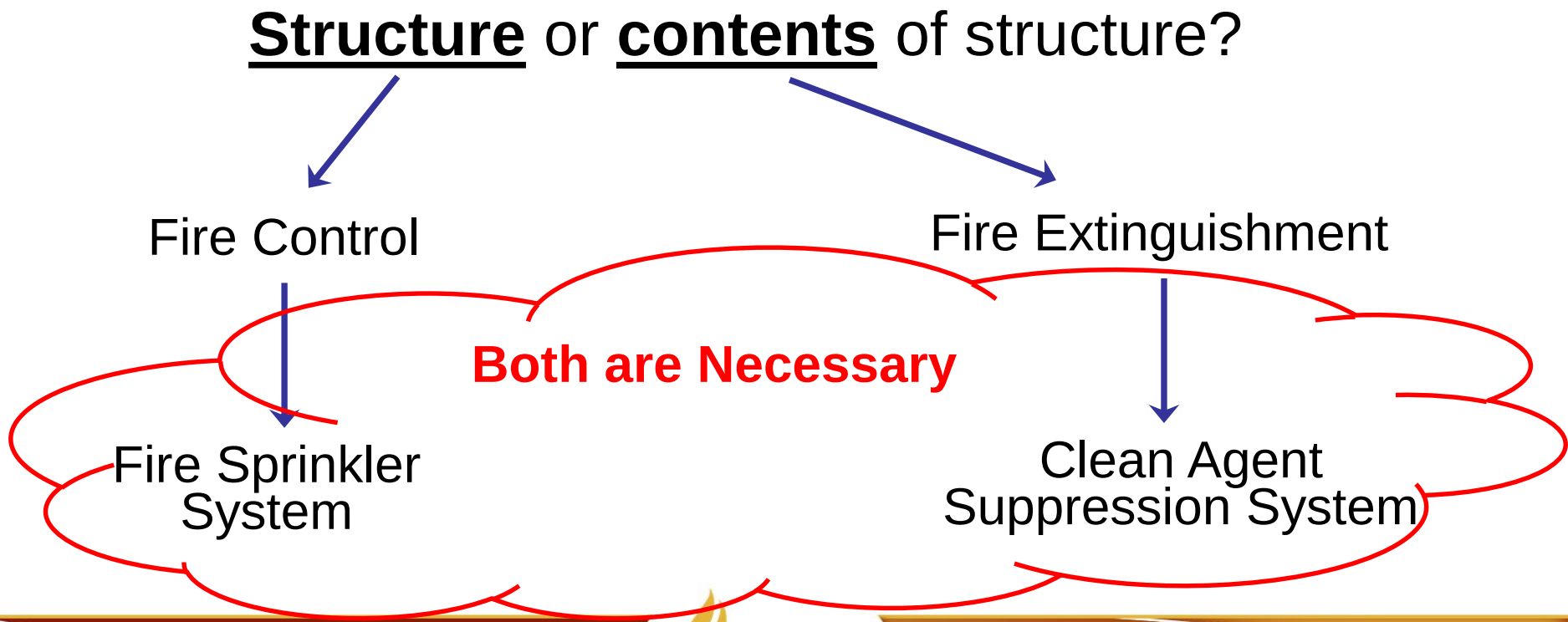
What are you protecting?



What are you protecting?

Structure or **contents** of structure?

Fire Control

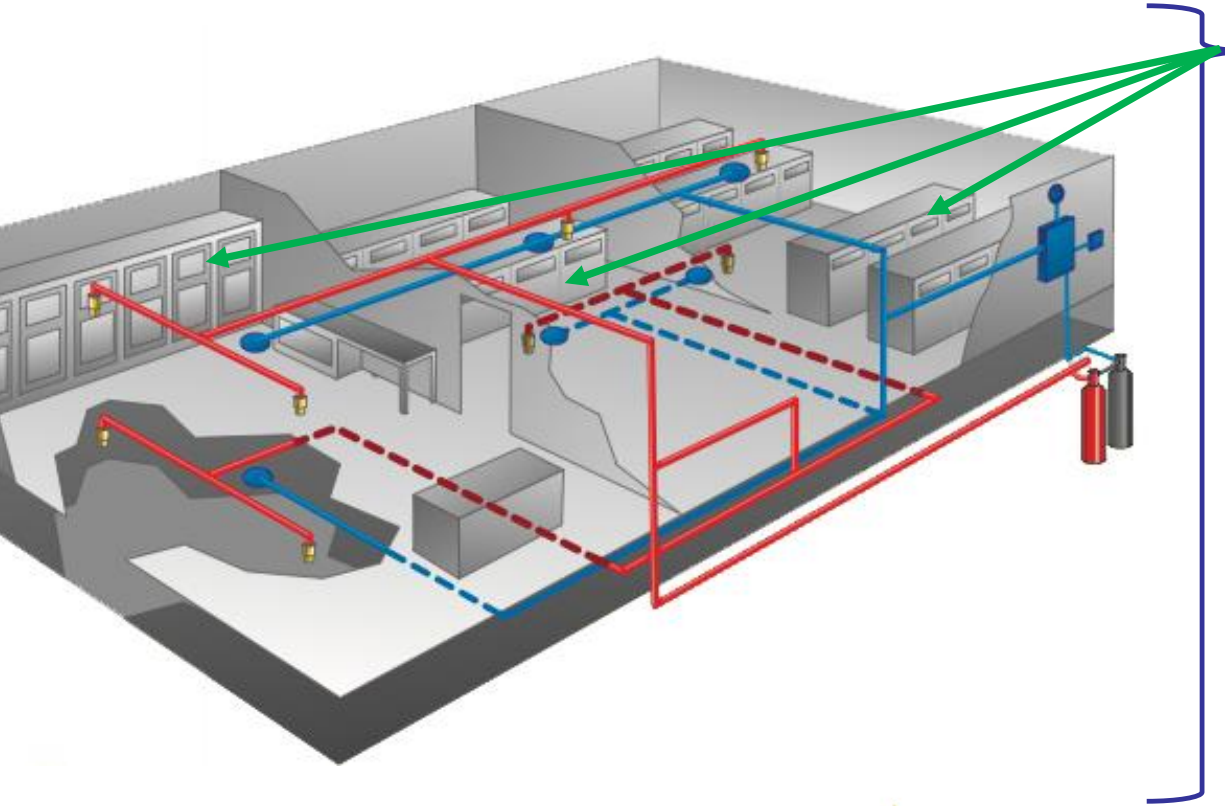
Fire Sprinkler System

FSSA Focus

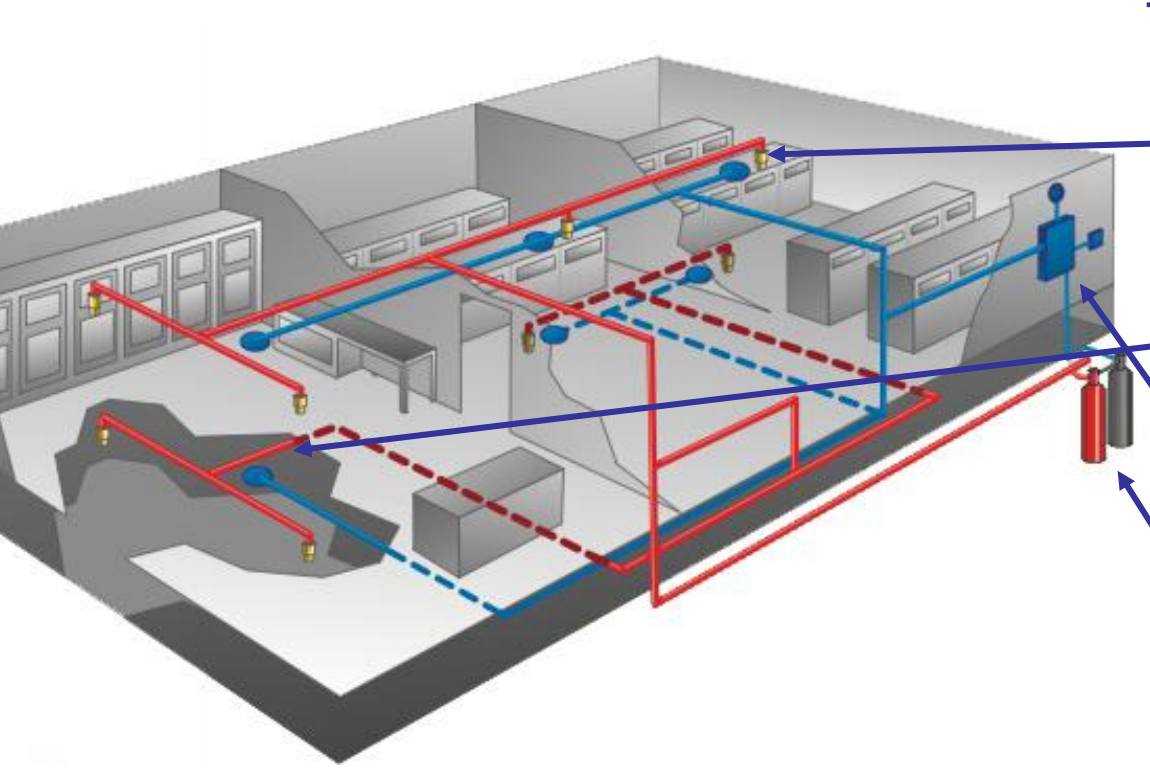
Fire Extinguishment

Clean Agent Suppression System

Clean Agents for Fire Extinguishment



Clean Agents for Fire Extinguishment



Clean Agent System

- Above-Floor Protection Piping Network and Discharge Nozzles
- Below-Floor Protection Piping Network and Discharge Nozzles
- Releasing Panel with Detection and Control
- Container with Clean Agent

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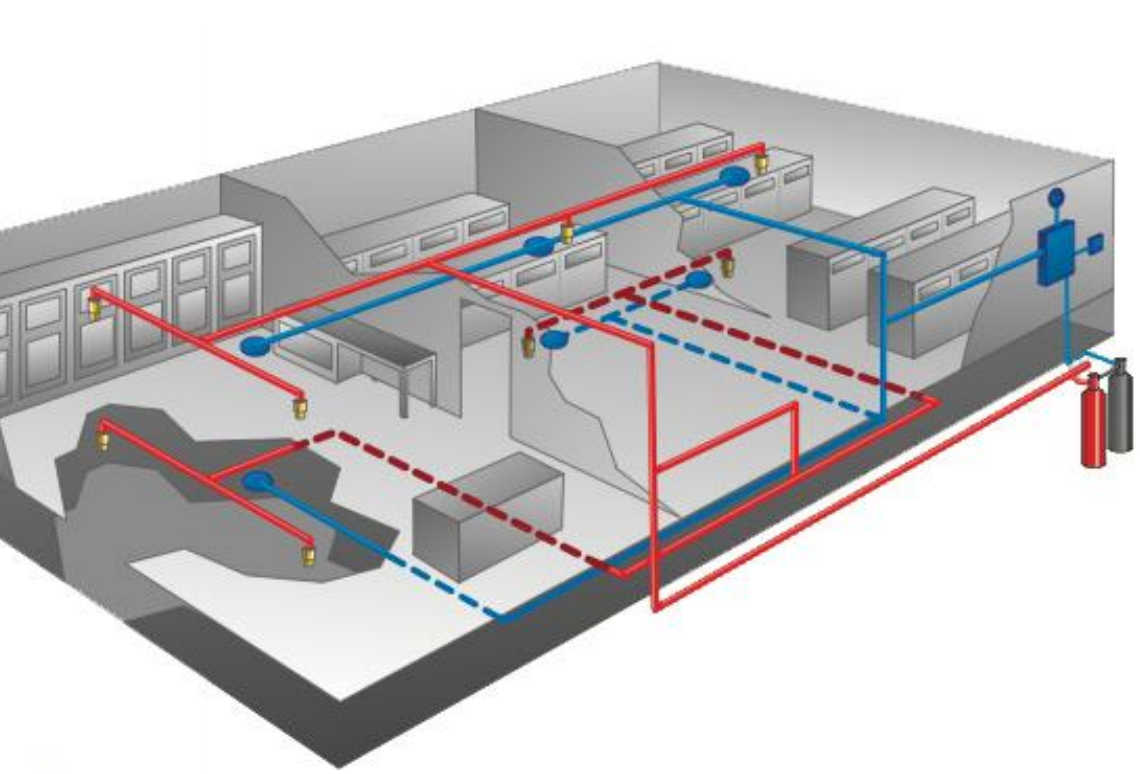
Clean Agents for Fire Extinguishment



Clean Agent System

- A **System Manufacturer** designs and lists their Clean Agent System for a specific Clean Agent.
- An **Installer** represents the System Manufacturer and installs the Clean Agent System for the **Owner** to protect their **Special Hazard**

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Key Players

Clean Agent Manufacturers

System Manufacturers

Installers

AHJs

Owners with Special Hazards to Protect

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Clean Agent Options - Groups

Clean Agent Options - Groups

Halocarbons

CFC's

- Halon 1301 - Bromotrifluoromethane $CBrF_3$

HFC's

- HFC-227ea - Heptafluoropropane C_2HF_7 (Chemours™ FM-200™)
- HFC-125 - Pentafluoroethane C_2HF_5 (Chemours™ FE-25™)
- HFC-23 - Trifluoromethane CHF_3 (Chemours™ FE-13™)

FK's

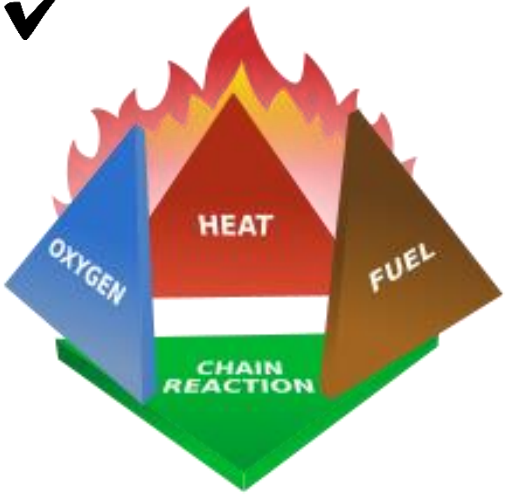
- FK-5-1-12 - a fluorinated ketone $C_6F_{12}O$ (3M™ Novec™ 1230)

Inert Gases & Blends

- IG-01 - Argon
- IG-100 - Nitrogen
- IG-55 - Argonite (Argon & Nitrogen Mix)
- IG-541 - 52% Nitrogen, 40% Argon, and 8% CO_2 (Ansul Inergen)

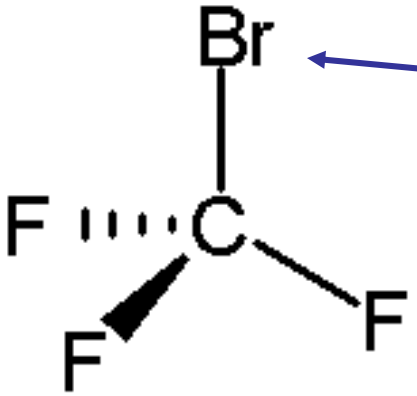
How Do Clean Agents Work?

	Halocarbons	*Inert Gases & Blends*
Oxygen Depletion		✓
Heat Absorption	✓	
Reaction Interruption	✓	

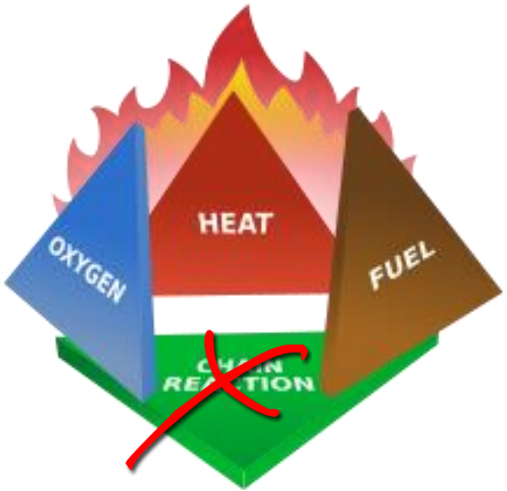


Fire Tetrahedron

Halocarbons and Reaction Interruption



Very Effective Clean Agent!



Fire Tetrahedron

Halon 1301 and the Environment

<u>But</u> - Negative Impact to the Environment!

Halon 1301 contributes to the depletion of the ozone layer

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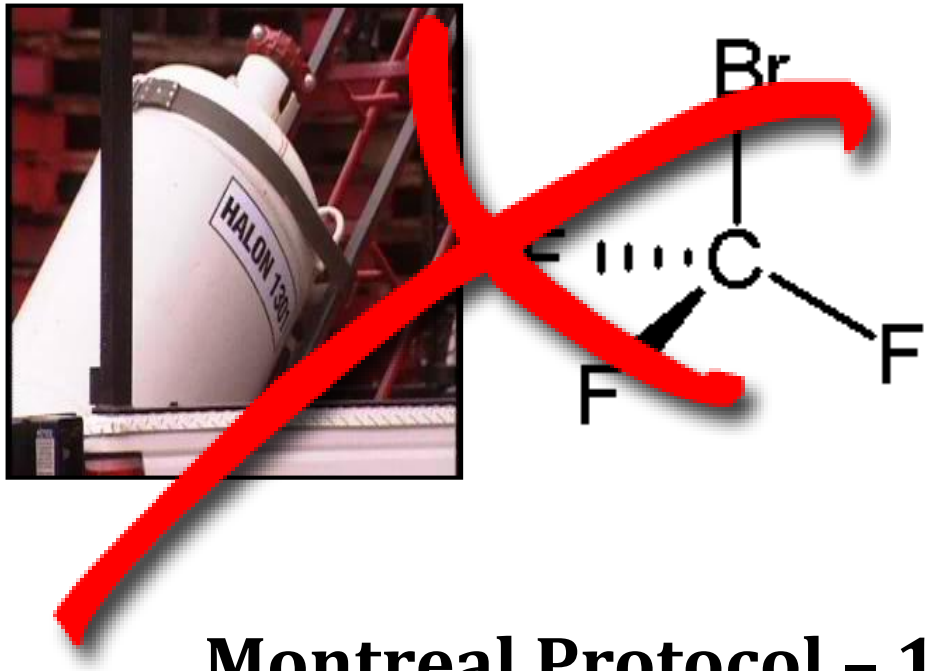
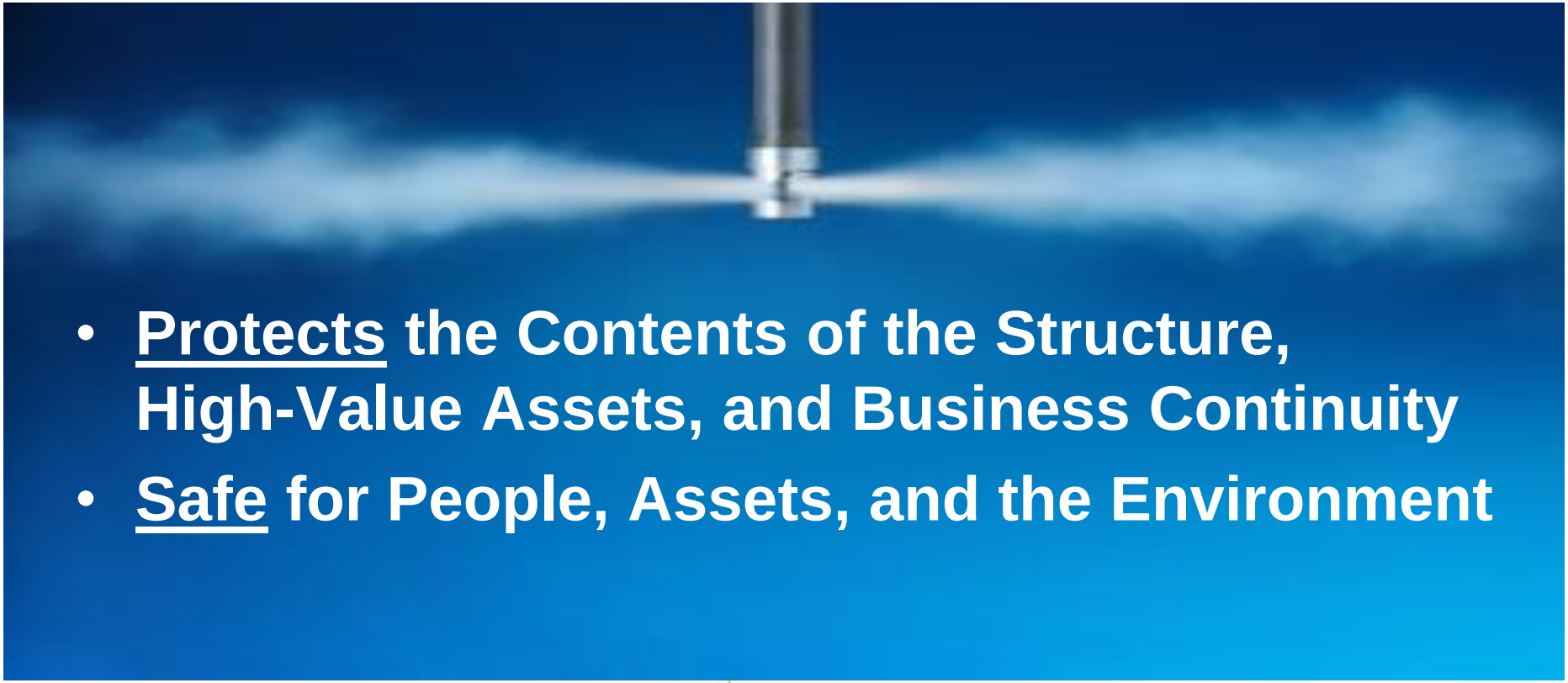
What Happened to Halon 1301?



Montreal Protocol – 12/31/93


Now what?

Need Halon 1301 Alternative(s)

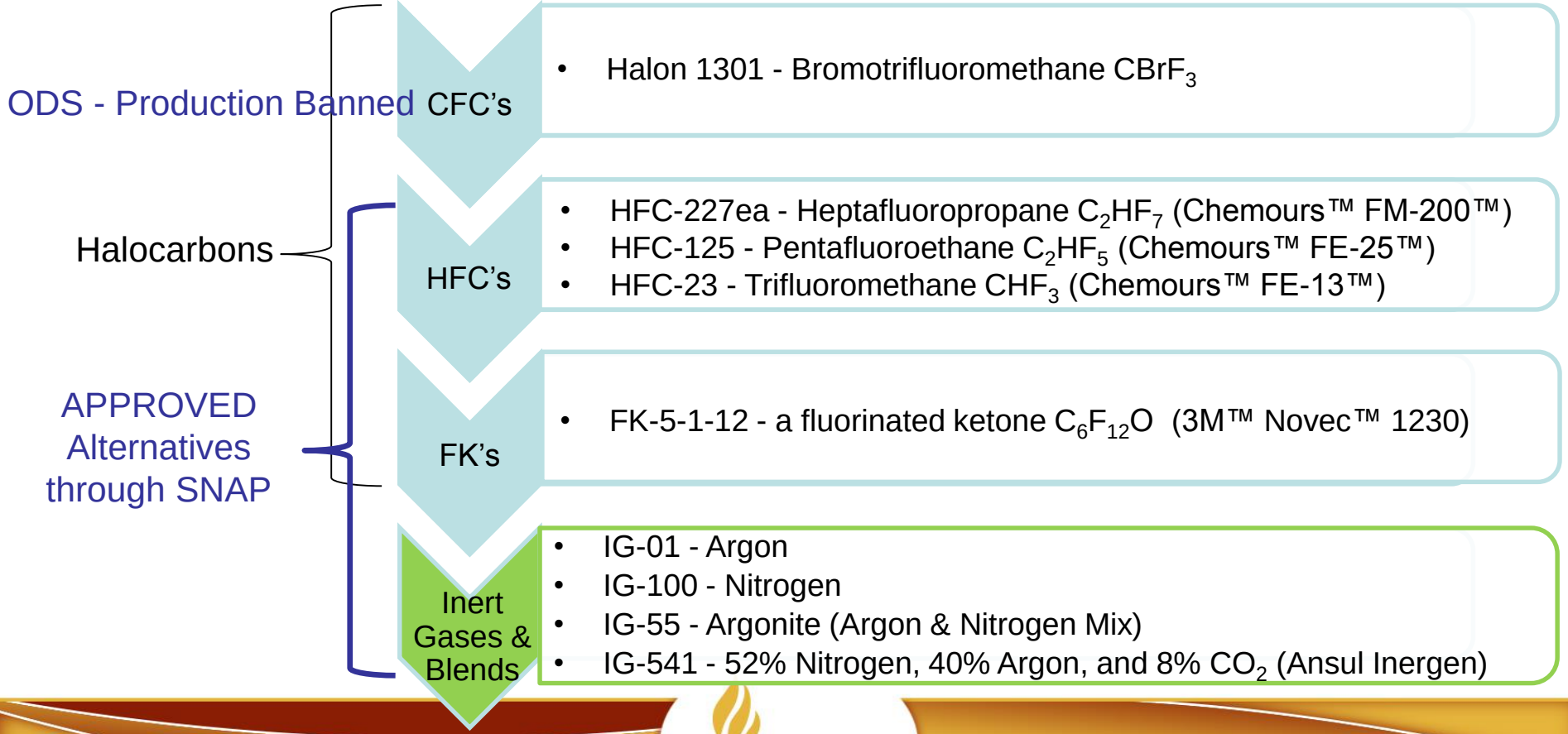


- **Protects the Contents of the Structure, High-Value Assets, and Business Continuity**
- **Safe for People, Assets, and the Environment**

Significant New Alternatives Policy-SNAP

- Developed by the EPA as part of the Clean Air Act
- Evaluate agents developed as alternatives for Ozone Depleting Substances (ODS) like Halon 1301
- Approved Agents :
    - same suppression qualities as Halon
    - non-ozone depleting
    - not harmful to people or the environment
- Regulates safe usage
- Program continues as part of the NFPA

Clean Agent Options - Groups



Key Players

Clean Agent Manufacturers

System Manufacturers

Installers

AHJs

Owners with Special Hazards to Protect

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- **Clean Agent System Design**
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Clean Agent Design

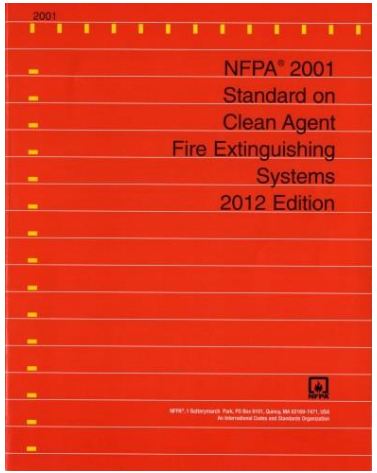


Image: NFPA

Why, Where and When

Why Do We Use Clean Agents:

- Building contents include valuable commodities
- Minimize downtime from a fire event

- Early detection and extinguishment reduces smoke damage
- Clean, No Residue, Electrically Non-Conductive
- 3-D, shielded objects

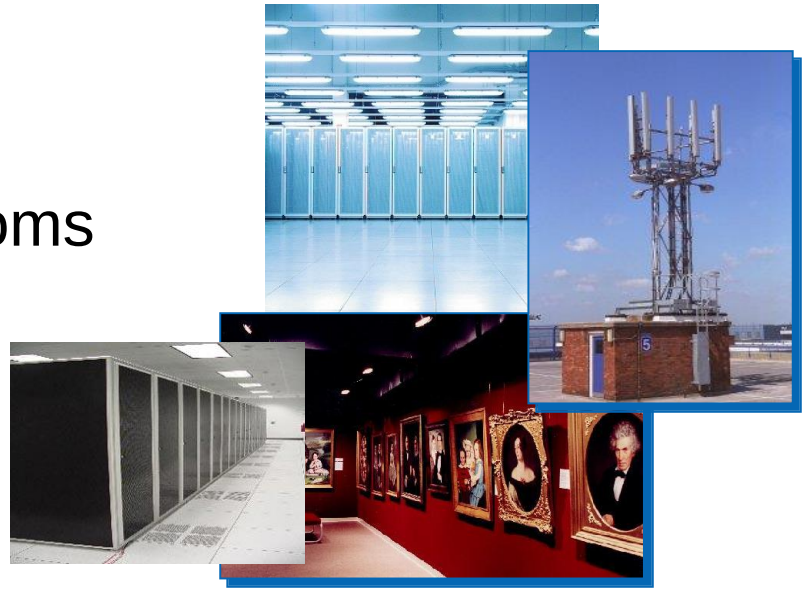
- NO BUSINESS INTERRUPTION!!!

Why, Where and When

Where Do We Consider Use of Clean Agents:

- Data Centers / Computer Rooms (Everyone has one)
- File Storage
- Wind Turbines
- Museums / Art Galleries / Libraries
- Electrical Vaults / Switch Gear Rooms
- Cell Sites
- Rare Car Storage

- Almost Always and Everywhere!!



Why, Where and When

When Do We Consider Use of Clean Agents:

- Owner Request
- Engineer Specifications
- Contractor Suggestion

Clean Agent Design

Conceptual Design:

Space planning
- How many Cylinders?
- How large are the Cylinders?

How do we determine the amount of Agent Required?
- Select Agent type
- Determine the design concentration
- Volume of the space being protected LxWxH

Halocarbon Design

Minimum Design Concentrations
Based on the NFPA 2001 Standard

	FK-5-1-12 **(Novec™ 1230)**	HFC-227ea **(FM-200™)**	HFC-125 **(FE-25™)**	
Class A/C (2008 ed)	4.2%	6.25%	8.0%	
Class A (2012 ed)	**4.5%**	**7.0%**	**8.7%**	10,000 ft^3 room
Class C (2012 ed)	**4.7%**	**7.9%**	**9.0%**	
Class B (2008 & 2012 ed)	5.85%	8.7%	11.3%	

NFPA 2001

Halocarbon Design

Table A.5.5.1(a) FK-5-1-12 Total Flooding Quantity (U.S. Units)[a]

Table: NFPA 2001

4.5%

Temp (t) (°F)[c]	Specific Vapor Volume (s) (ft³/lb)[d]	Weight Requirements of Hazard Volume, W/V (lb/ft³)[b] Design Concentration (% by Volume)[e] 3	4	5	6	7	8	9	10
–20	0.93678	0.0330	0.0445	0.0562	0.0681	0.0803	0.0928	0.1056	0.1186
–10	0.96119	0.0322	0.0433	0.0548	0.0664	0.0783	0.0905	0.1029	0.1156
0	0.9856	0.0314	0.0423	0.0534	0.0648	0.0764	0.0882	0.1003	0.1127
10	1.01001	0.0306	0.0413	0.0521	0.0632	0.0745	0.0861	0.0979	0.1100
20	1.03442	0.0299	0.0403	0.0509	0.0617	0.0728	0.0841	0.0956	0.1074
30	1.05883	0.0292	0.0394	0.0497	0.0603	0.0711	0.0821	0.0934	0.1049
40	1.08324	0.0286	0.0385	0.0486	0.0589	0.0695	0.0803	0.0913	0.1026
50	1.10765	0.0279	0.0376	0.0475	0.0576	0.0680	0.0785	0.0893	0.1003
60	1.13206	0.0273	0.0368	0.0465	0.0564	0.0665	0.0768	0.0874	0.0981
70	1.15647	0.0267	0.0360	0.0455	0.0552	0.0651	0.0752	0.0855	0.0961
80	1.18088	0.0262	0.0353	0.0446	0.0541	0.0637	0.0736	0.0838	0.0941
90	1.20529	0.0257	0.0346	0.0437	0.0530	0.0624	0.0721	0.0821	0.0922
100	1.22970	0.0252	0.0339	0.0428	0.0519	0.0612	0.0707	0.0804	0.0904
110	1.25411	0.0247	0.0332	0.0420	0.0509	0.0600	0.0693	0.0789	0.0886
120	1.27852	0.0242	0.0325	0.0412	0.0499	0.0589	0.0680	0.0774	0.0869
130	1.30293	0.0237	0.0319	0.0404	0.0490	0.0578	0.0667	0.0759	0.0853
140	1.32734	0.0233	0.0313	0.0397	0.0481	0.0567	0.0655	0.0745	0.0837
150	1.35175	0.0229	0.0308	0.0390	0.0472	0.0557	0.0643	0.0732	0.0822
160	1.37616	0.0225	0.0302	0.0383	0.0464	0.0547	0.0632	0.0719	0.0807
170	1.40057	0.0221	0.0297	0.0376	0.0456	0.0537	0.0621	0.0706	0.0793
180	1.42498	0.0217	0.0292	0.0369	0.0448	0.0528	0.0610	0.0694	0.0780
190	1.44939	0.0213	0.0287	0.0363	0.0440	0.0519	0.0600	0.0682	0.0767
200								0.0671	0.0754
210								0.0660	0.0742
220								0.0650	0.0730

4.5% = 0.04075

0.04075 x volume (10,000 ft³) = 407.5 lbs

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Halocarbon Design

Table A.5.5.1(i) HFC-227ea Total Flooding Quantity (U.S. Units)[a]

Table: NFPA 2001

Temp (*t*) (°F)[c]	Specific Vapor Volume (*s*) (ft^3/lb)[d]	Weight Requirements of Hazard Volume, *W*/*V* (lb/ft^3)[b] Design Concentration (% by Volume)[e]									
		6	7	8	9	10	11	12	13	14	15
10	1.9264	0.0331	0.0391	0.0451	0.0513	0.0570	0.0642	0.0708	0.0776	0.0845	0.0916
20	1.9736	0.0323	0.0381	0.0441	0.0501	0.0563	0.0626	0.0691	0.0757	0.0825	0.0894
30	2.0210	0.0316	0.0372	0.0430	0.0489	0.0550	0.0612	0.0675	0.0739	0.0805	0.0873
40	2.0678	0.0309	0.0364	0.0421	0.0478	0.0537	0.0598	0.0659	0.0723	0.0787	0.0853
50	2.1146	0.0302	0.0356	0.0411	0.0468	0.0525	0.0584	0.0645	0.0707	0.0770	0.0835
60	2.1612	0.0295	0.0348	0.0402	0.0458	0.0514	0.0572	0.0631	0.0691	0.0753	0.0817
70	2.2075	0.0289	0.0341	0.0394	0.0448	0.0503	0.0560	0.0618	0.0677	0.0737	0.0799
80	2.2538	0.0283	0.0334	0.0386	0.0439	0.0493	0.0548	0.0605	0.0663	0.0722	0.0783
90	2.2994	0.0278	0.0327	0.0378	0.0430	0.0483	0.0538	0.0593	0.0650	0.0708	0.0767
100	2.3452	0.0272	0.0321	0.0371	0.0422	0.0474	0.0527	0.0581	0.0637	0.0694	0.0752
110	2.3912	0.0267	0.0315	0.0364	0.0414	0.0465	0.0517	0.0570	0.0625	0.0681	0.0738
120	2.4366	0.0262	0.0309	0.0357	0.0406	0.0456	0.0507	0.0560	0.0613	0.0668	0.0724
130	2.4820	0.0257	0.0303	0.0350	0.0398	0.0448	0.0498	0.0549	0.0602	0.0656	0.0711
140	2.5272	0.0252	0.0298	0.0344	0.0391	0.0440	0.0489	0.0540	0.0591	0.0644	0.0698
150	2.5727	0.0248	0.0292	0.0338	0.0384	0.0432	0.0480	0.0530	0.0581	0.0633	0.0686
160	2.6171	0.0244	0.0288	0.0332	0.0378	0.0425	0.0472	0.0521	0.0571	0.0622	0.0674
170	2.6624	0.0240	0.0283	0.0327	0.0371	0.0417	0.0464	0.0512	0.0561	0.0611	0.0663
180	2.7071	0.0236	0.0278	0.0321	0.0365	0.0410	0.0457	0.0504	0.0552	0.0601	0.0652
190									0.0543	0.0592	0.0641
200									0.0535	0.0582	0.0631

7% = 0.0341

0.0341 x volume (10,000 ft^3) = 341 lbs

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Halocarbon Design

Calculations:

$$W = \frac{V}{s}\left[\frac{C}{100 - C}\right]$$

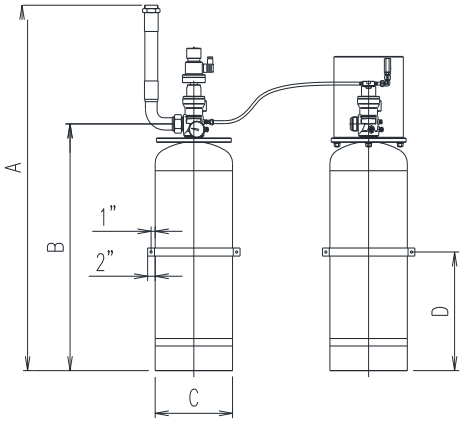
$$C = \frac{100 \times s \times W}{s \times W + V}$$

$$FF = \frac{1}{s}\left[\frac{C}{100 - C}\right]$$

- W = Weight of Agent
- V = Volume of Protected space (ft^3)
- s = Specific Vapor Volume (ft^3/lb)
  (s = .9856 + .002441 (t))
- C = Concentration %
- FF = Flooding Factor

Halocarbon Design

Cylinder Sizes



PRESSURE AT 70° F (20° C)	NOMINAL VOLUME	A (in.)	B (in.)	C (in.)	D (in.)	AMOUNT FILLED MIN.	AMOUNT FILLED MAX.	EMPTY WEIGHT
360 PSI (25 bar)	140 lb	71.4	47.8	10	27.5	46 lbs	137 lbs	108 lbs
	280 lb	67.2	40.9	16	27.5	94 lbs	280 lbs	190 lbs
	390 lb	80.4	54.0	16	41.4	130 lbs	388 lbs	229 lbs
	500 lb	82.0	61.5	16	51.2	159 lbs	476 lbs	313 lbs
725 PSI (50 bar)	220 lb	58.5	34.9	16	23.6	71 lbs	211 lbs	218 lbs
	390 lb	80.2	53.8	16	41.4	124 lbs	370 lbs	289 lbs
	500 lb	93.6	67.2	16	51.2	159 lbs	476 lbs	395 lbs

[2] all dimensions are approximately, variations due to manufacturing tolerances are possible

Clean Agent Design

Health and Safety Considerations

All Clean Agents recognized in NFPA 2001 must be evaluated and listed under the EPA – SNAP Program

Safety levels expressed by NOAEL and LOAEL designation

- NOAEL - **No Observable Adverse Effect Level**
  The highest concentration at which no adverse toxicological or physiological effect has been observed
- LOAEL - **Lowest Observable Adverse Effect Level**
  The lowest concentration at which an adverse physiological or toxicological effect has been observed.

Clean Agent Design

Safety Margins

	FK-5-1-12 (Novec™ 1230)	HFC-227ea (FM-200™)	HFC-125 (FE-25™)	IG-01 (Argon)	IG-541 (Inergen)
NOAEL	**10%**	**9%**	**7.5%**		
LOAEL	**>10%**	**10.5%**	**10%**		
No Effect Level	**-**	**-**	**-**	**43%**	**52%**
Low Effect Level	**-**	**-**	**-**	**43%**	**52%**

Clean Agent Design

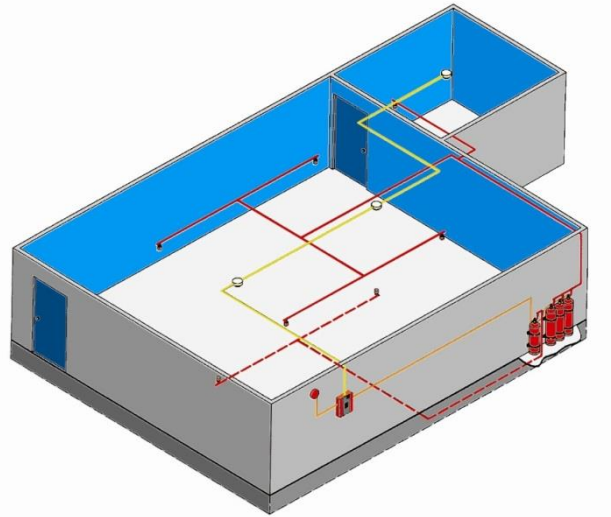
Global Warming is the Current Environmental Challenge

Properties	Halon 1301	FK-5-1-12 (Novec™ 1230)	HFC-227ea (FM-200™)	HFC-125 (FE-25™)	IG-01 (Argon)	IG-541 (Inergen)
Ozone Depletion Potential (ODP)	**12**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Global Warming Potential (GWP)	**6900**	**1**	**3500**	**3400**	**0.0**	**0.0**
Atmospheric Lifetime (years)	**65**	**0.014**	**33**	**29**	**0.0**	**0.0**

Clean Agent Design

System Design Considerations

Room Requirements



- Length, width, and height
- Sub-floor
- Preferred tank location
- Room integrity
- Room must be tight enough to maintain concentration
- HVAC must be shut down unless it is self-contained
- Identify any enclosable openings
- Pressure relief venting may be required

Clean Agent Design

System Design Considerations

Electrical Requirements

- Detection
- Manual pull station
- Abort stations
- Alarm bell inside area (first warning)
- Pre-discharge horn strobe inside area (pre-discharge)
- Flashing strobes above each entrance into protected area
- Warning signs by alarms inside and outside of the room

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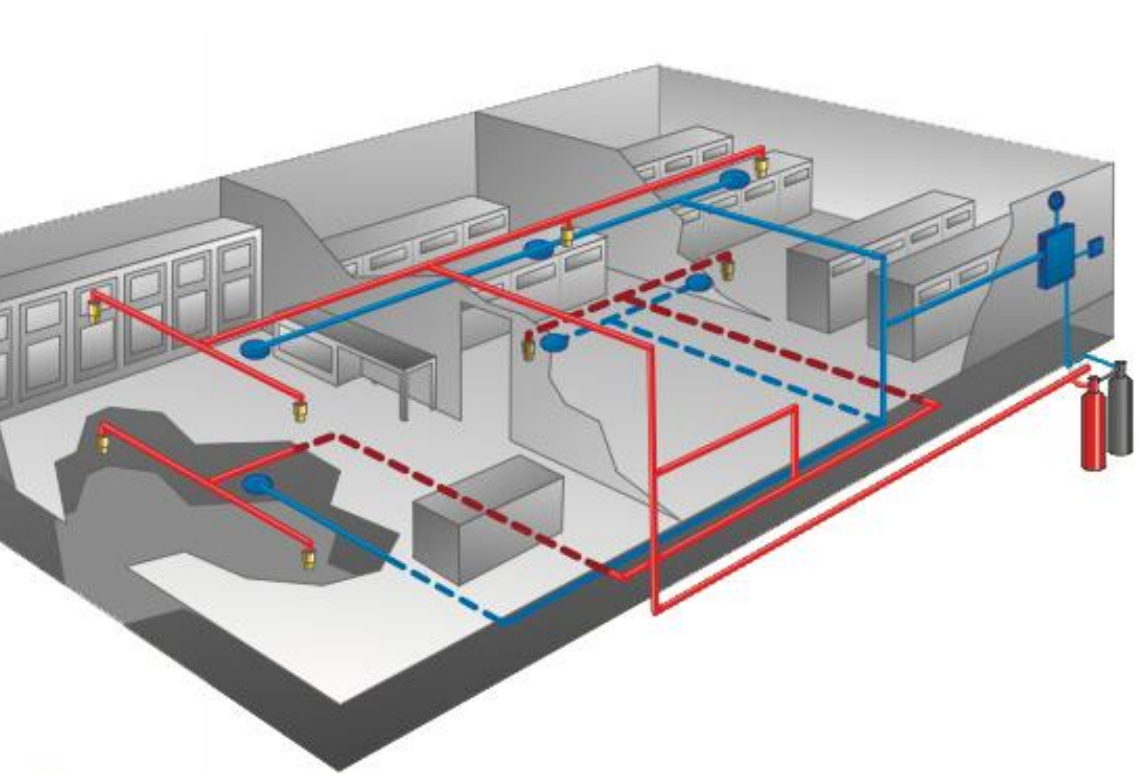
Your Clean Agent System



Fire!!???!!

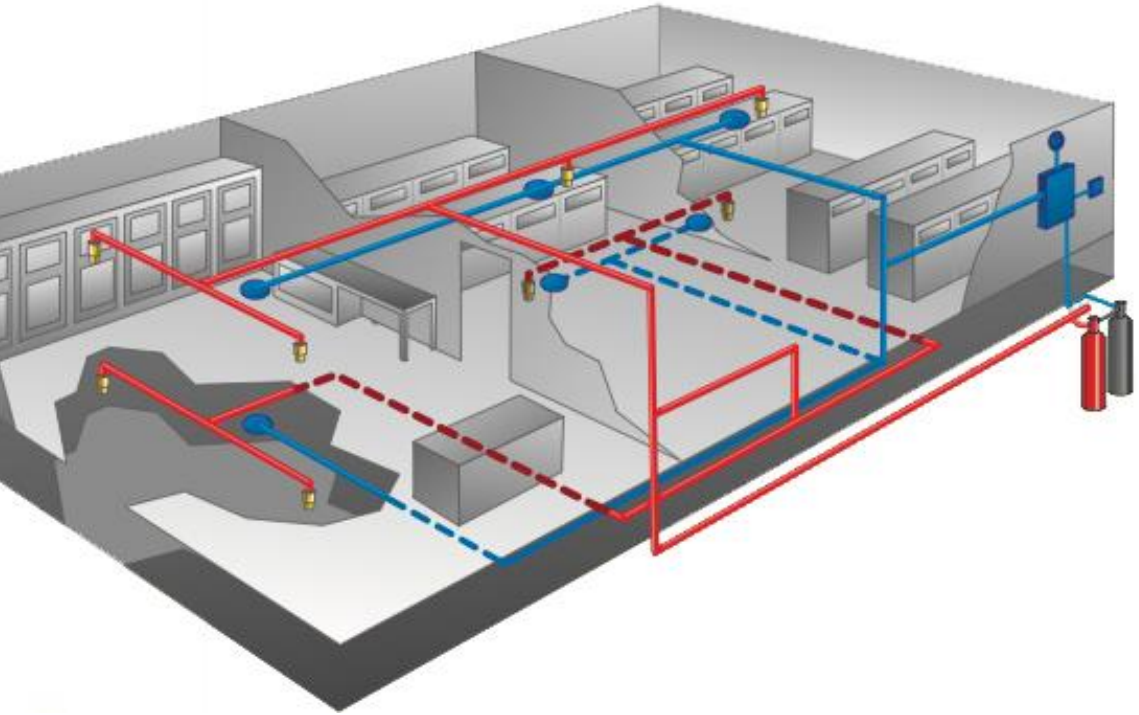
- 2 Smoke Detectors Initiate (Cross-Zoned)
- Pre-Discharge Horn Strobe
- Time Delay of 30s
- Investigate
- Abort or Evacuate?
- No Abort – Discharge

If Discharge

- No Fire Damage
- No Residue
- No Clean-Up
- No Business Interruption

FSSA
Fire Suppression Systems Association

Your Clean Agent System



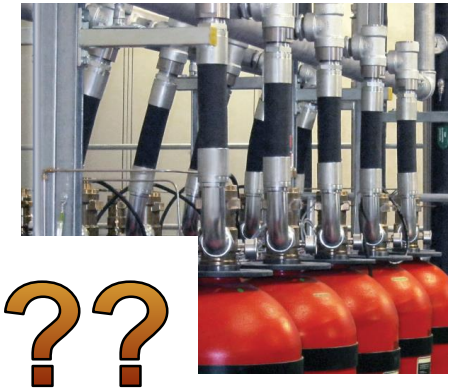
Test & Inspect

- Annual Inspection
- Semi-Annual Inspection
- Maintenance / Repair
- Training / Awareness

- FSSA Member Installer

FSSA
Fire Suppression Systems Association

Clean Agents 101



Questions??

FSSA
Fire Suppression Systems Association

FSSA Upcoming Events

More Information or Questions?

Visit www.fssa.net

or

Call the FSSA Headquarters at (410) 931-8100

FSSA
Fire Suppression Systems Association

FSSA Webinar
Clean Agents 101

Thank You!

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