

Novec

A New Class of Chemical Introduced to the Fire Protection Industry

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Chairman

The Association of Registered Fire Service Installation Contractors of Hong Kong

9 March 2007

The Institution of Fire Engineers (Hong Kong Branch)

One Day Symposium on Recent Fire Research and Its Implications for Fire Safety Engineering”

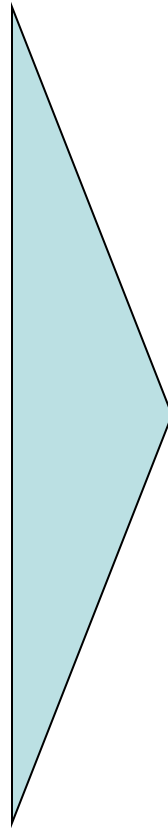
Content

- Review on development of Halon alternatives
- Gas extinguishing system in Hong Kong
- Novec as new chemical for gas extinguishing agency
- Shall Novec replace Halon?

Review on Halon Alternatives

From Old to New

Halon 1301



FM200

NAFS III

Halon
Alternatives

Inert Gas

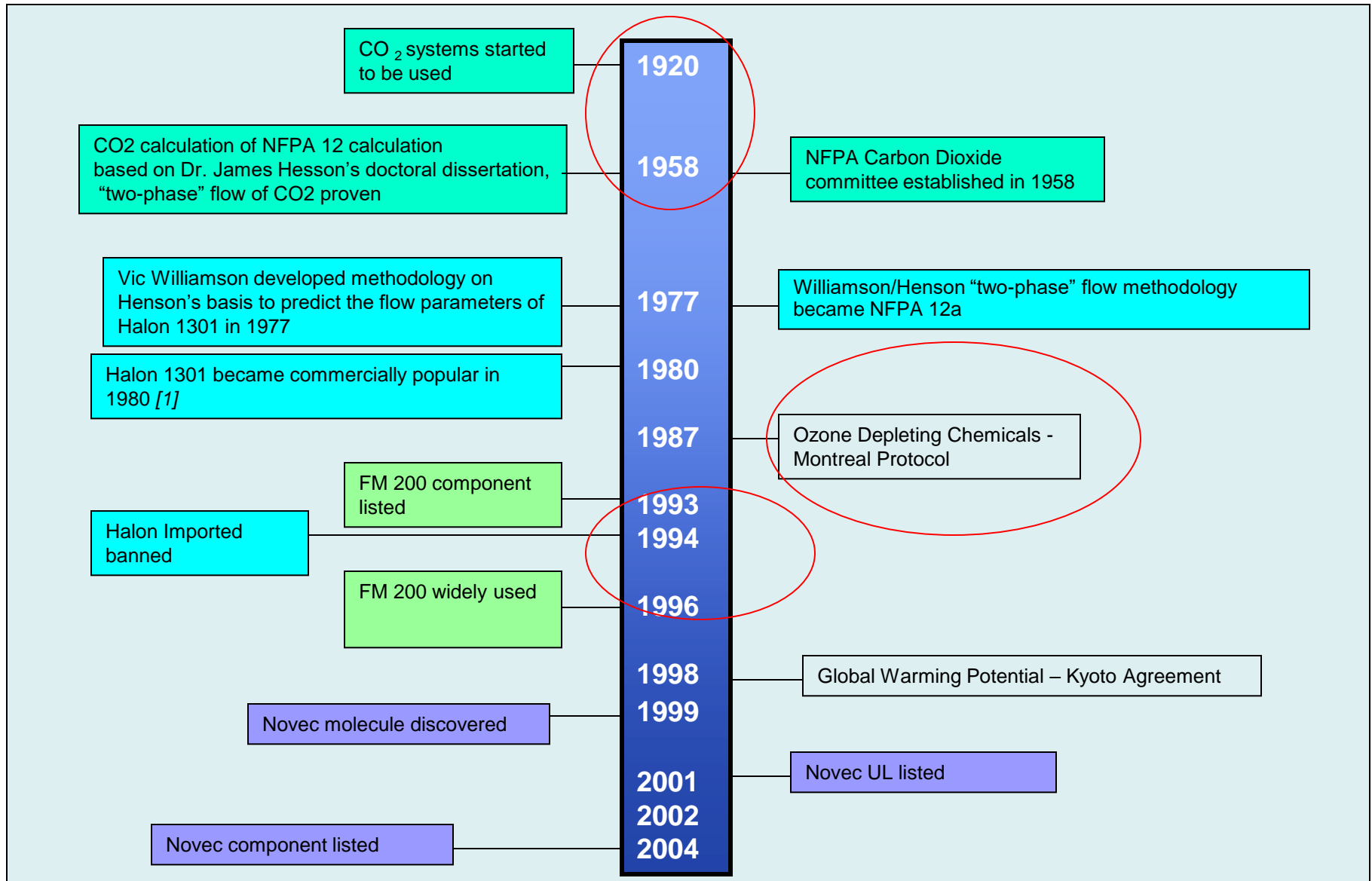
PFC 410

Alternatives to Halons – Expectations Vs Reality

Characteristic	Expectations	Reality
Extinguishing Effectiveness	More effective than Halons	Less effective than Halons
Cost	Less expensive than Halons	More expensive than Halons
Environmental Impact	Zero ozone depletion potential	Achieved
Safety	Safer than Halons	Achieved

Sources: Report on Status of industry efforts to replace Halon Fire Extinguishing agent, 2002, table 4

Development of Gas Extinguishing Systems



[1] Chamberlain & Boris, 1987, pp 55-59, Johnson, 1988, pp 41,60

History

Adobe Reader - [Halon 1301 history.pdf]

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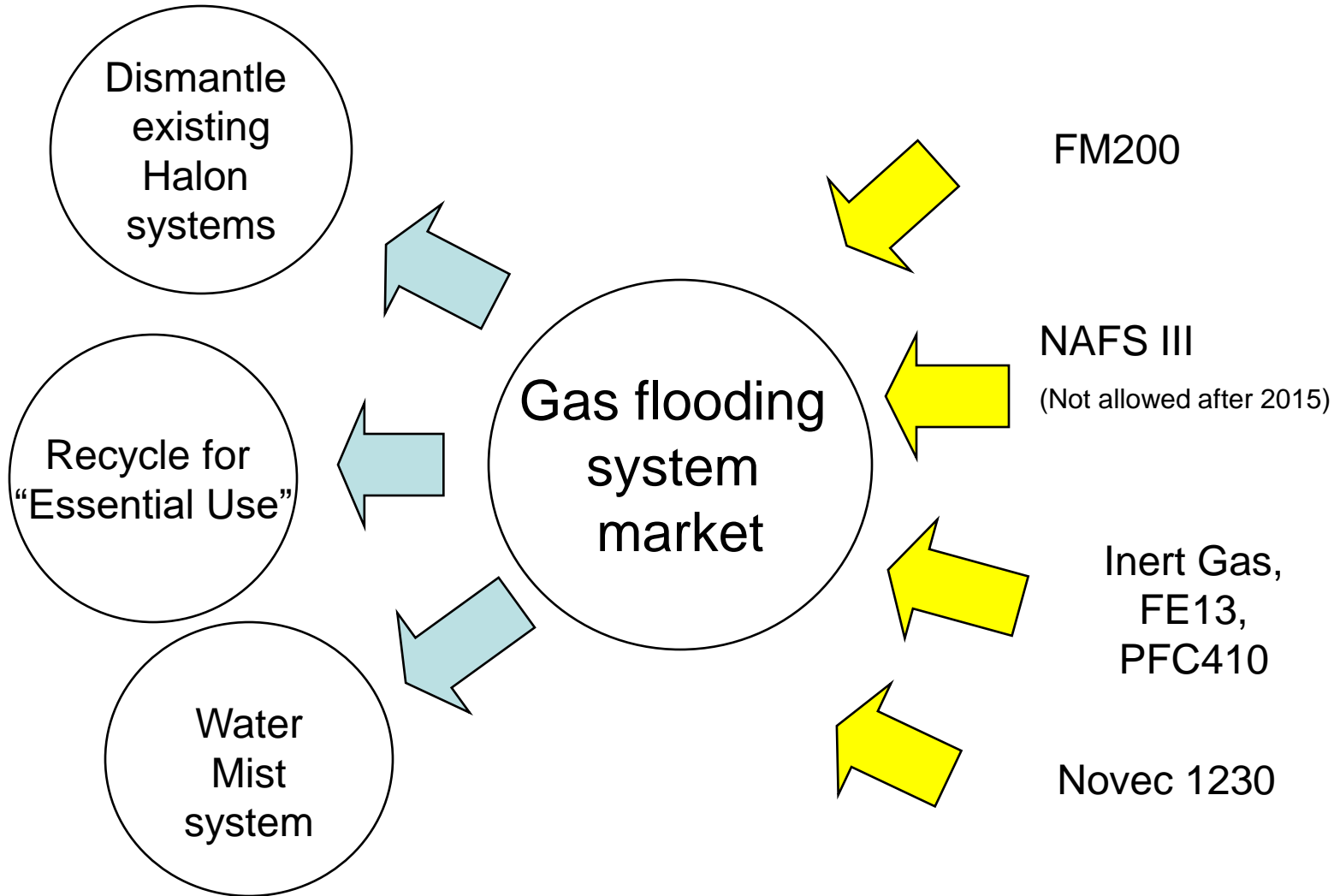
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Table 1. Fire Suppressants Evaluated in FAA Reports, 1943-1988

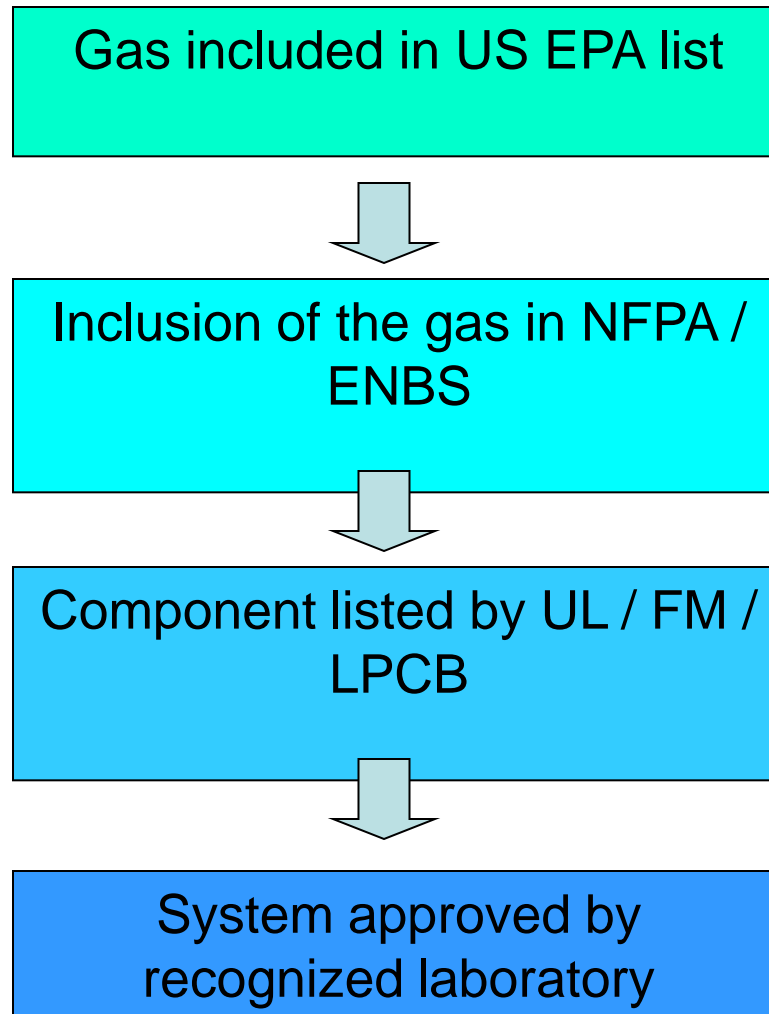
Report Number	Date	Fire Suppressant (chemical or Halon name)								
		C	O	2	1	1	1	2	1	1
31	Sep, 1943	x		x						
107	Apr, 1950	x								
184	Oct, 1952	x	x	x	x	x	x			
198	Apr, 1953	x		x	x			x		
205	Jun, 1953	x		x	x			x		
206*	Jun, 1953	x		x	x					
240	Jun, 1954				x			x		
260	Feb, 1956			x	x			x		x
365	Oct, 1958				x			x		x
403*	Sep, 1959	x		x	x			x		x
NA-69-26	Apr, 1969				x			x	x	x
FAA-DS-70-3*	Mar, 1970							x		x
FAA-RD-70-57	Nov, 1970									x
AFWAL-TR-87-2066	Nov, 1987							x		x
AFWAL-TR-88-2022	Jun, 1988							x		x

*Signifies work involved in developing gas concentration analysis equipment

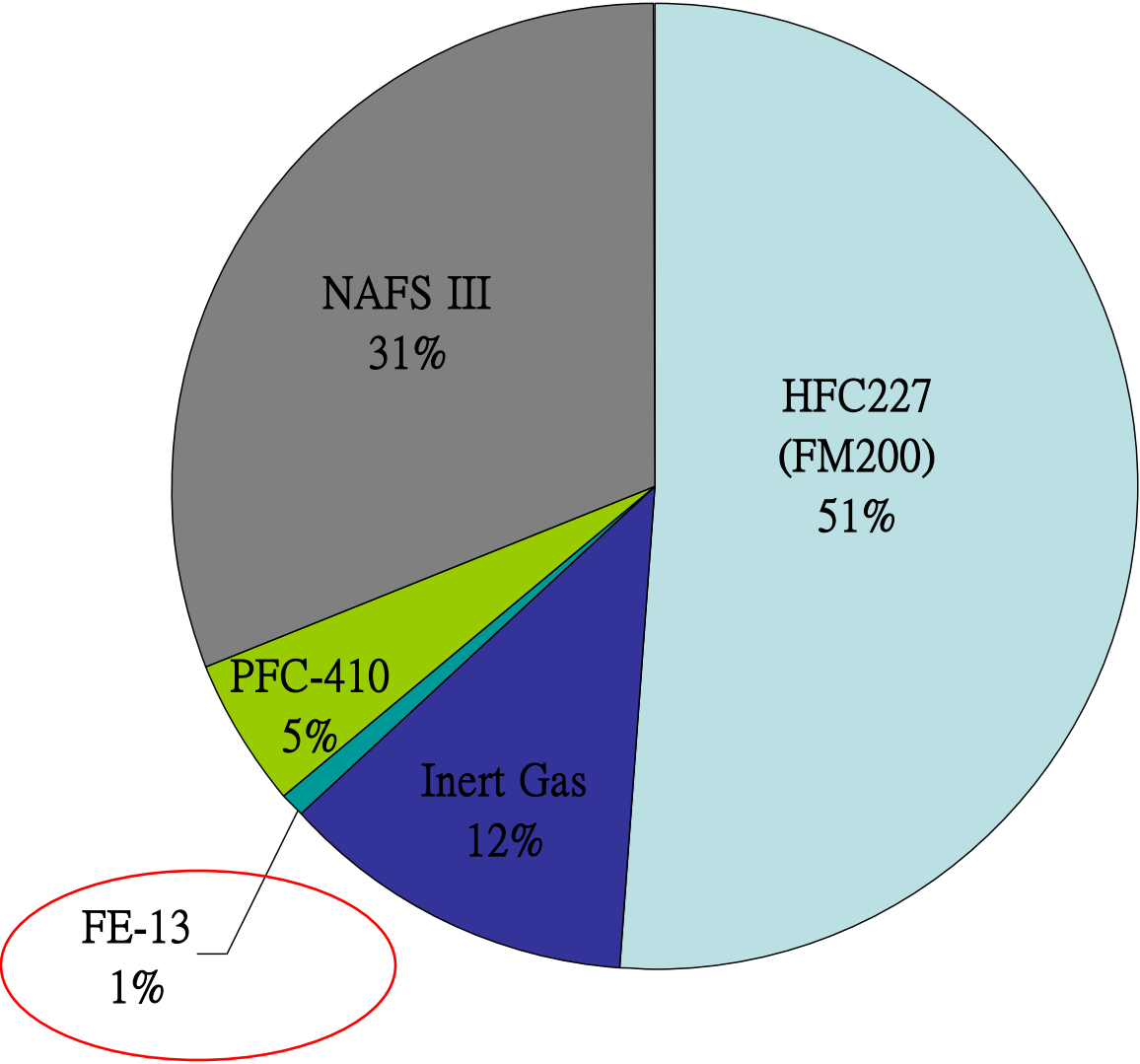
Gas System Market Move



Transaction Processes of Halon Alternatives



Market Share of Halon Alternatives



Source: Kidde, 2000

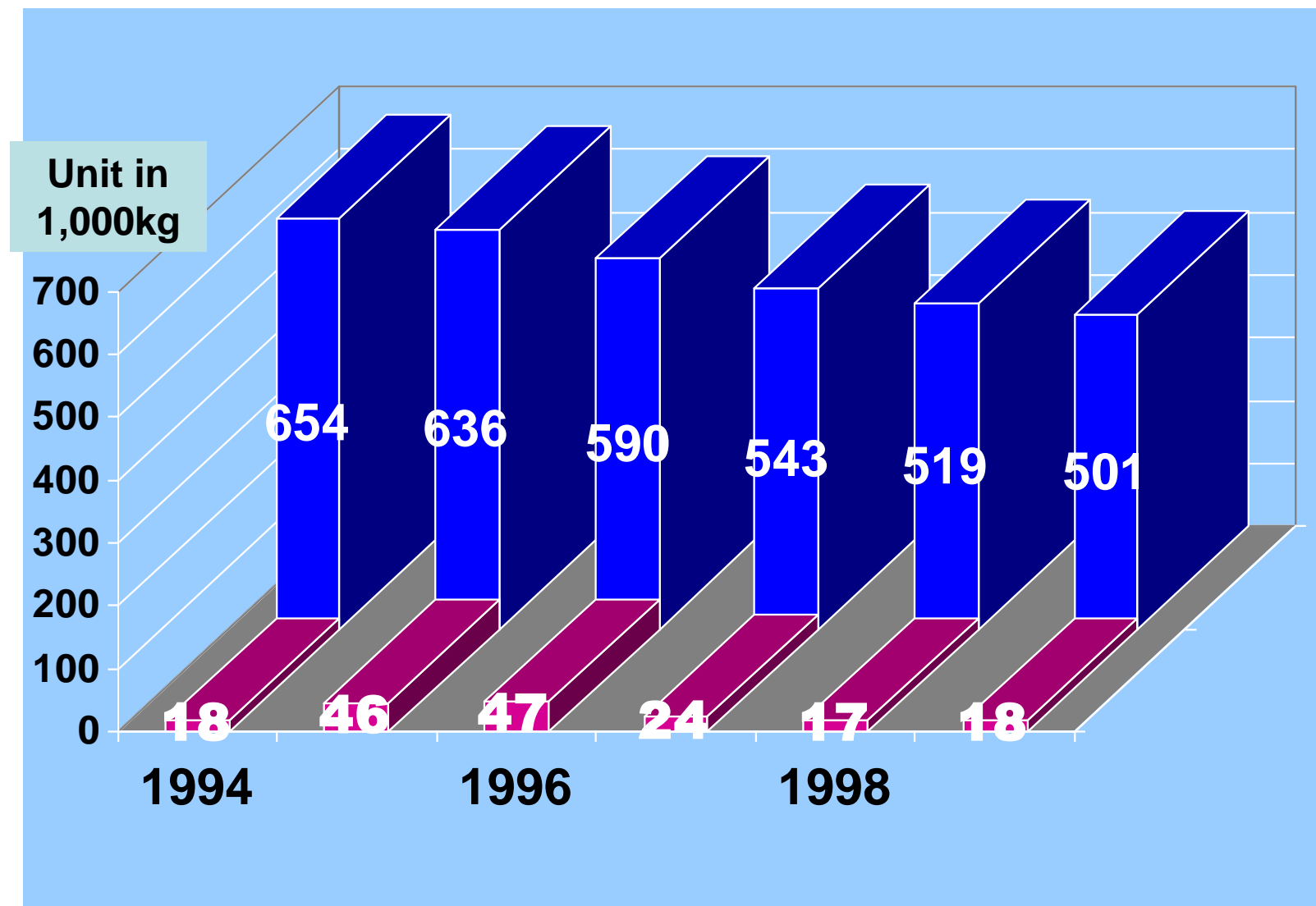
Gas extinguishing system in Hong Kong



消防入水點
F.S. INLET

26.02.2007

History of Halon



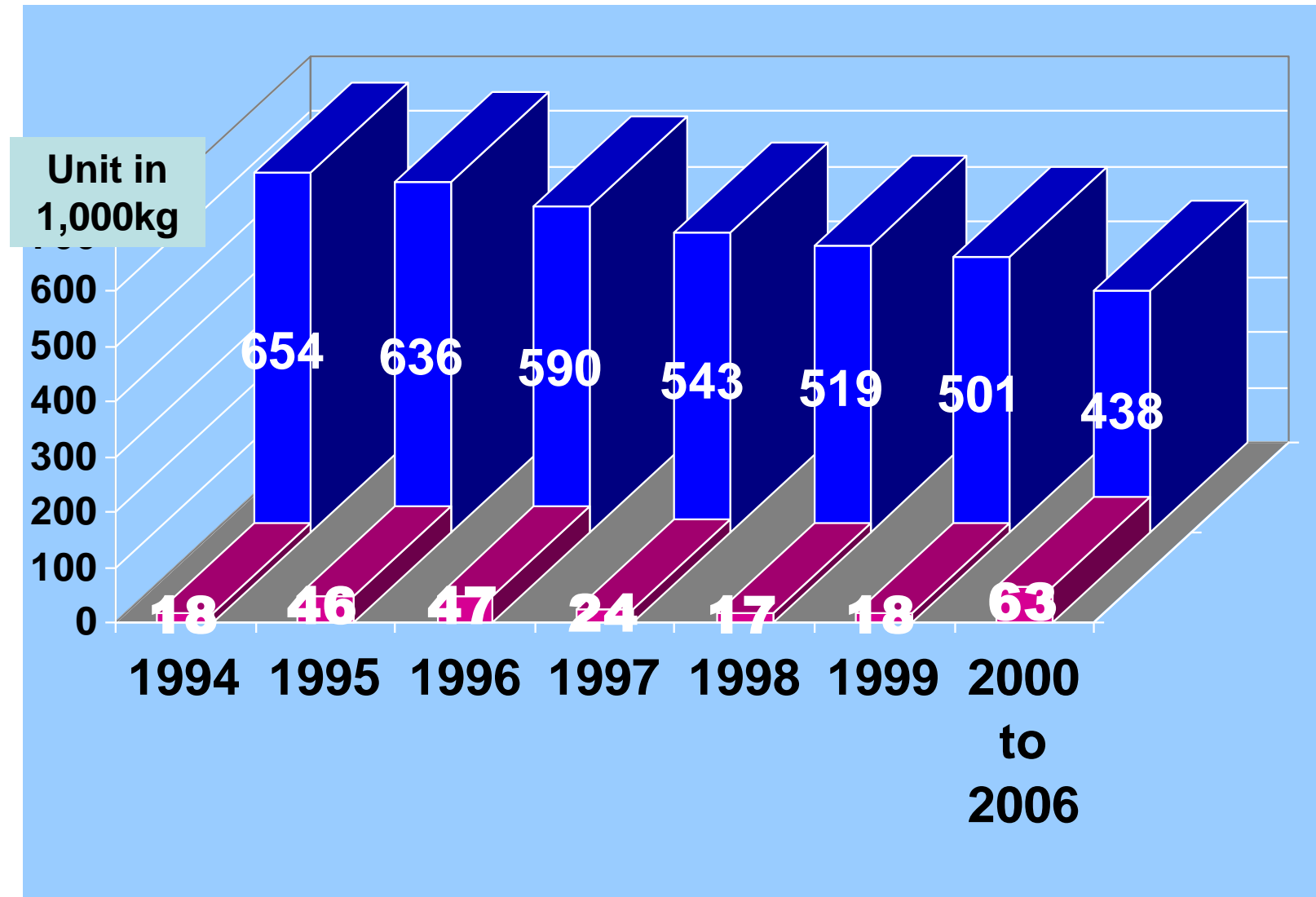
Source: Survey conducted by EPD, The Government of HKSAR in 2000

Gaseous Systems Usage in Hong Kong

(in kg)	2000	2001	2002	2003	2004	2005	2006
FM200	36,666	31,285	48,354	65,687	51,463	52,122	76,513
Halon	0	1,000	1,000	1,000	0	327	0
Novec							

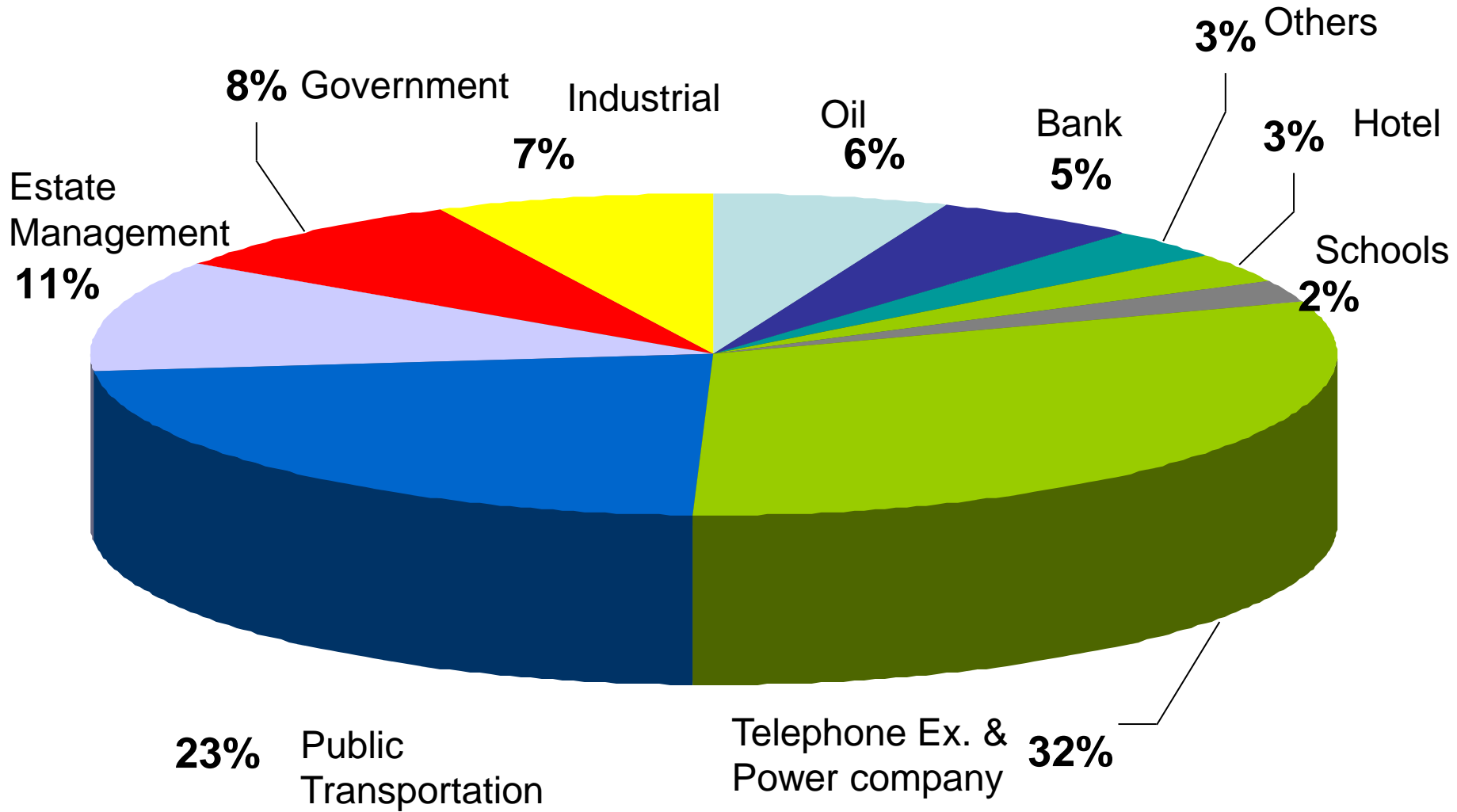
Source: Census and Statistic Department of HKSAR, Imports of Selected HS items by Country

Existing Halon Forecast



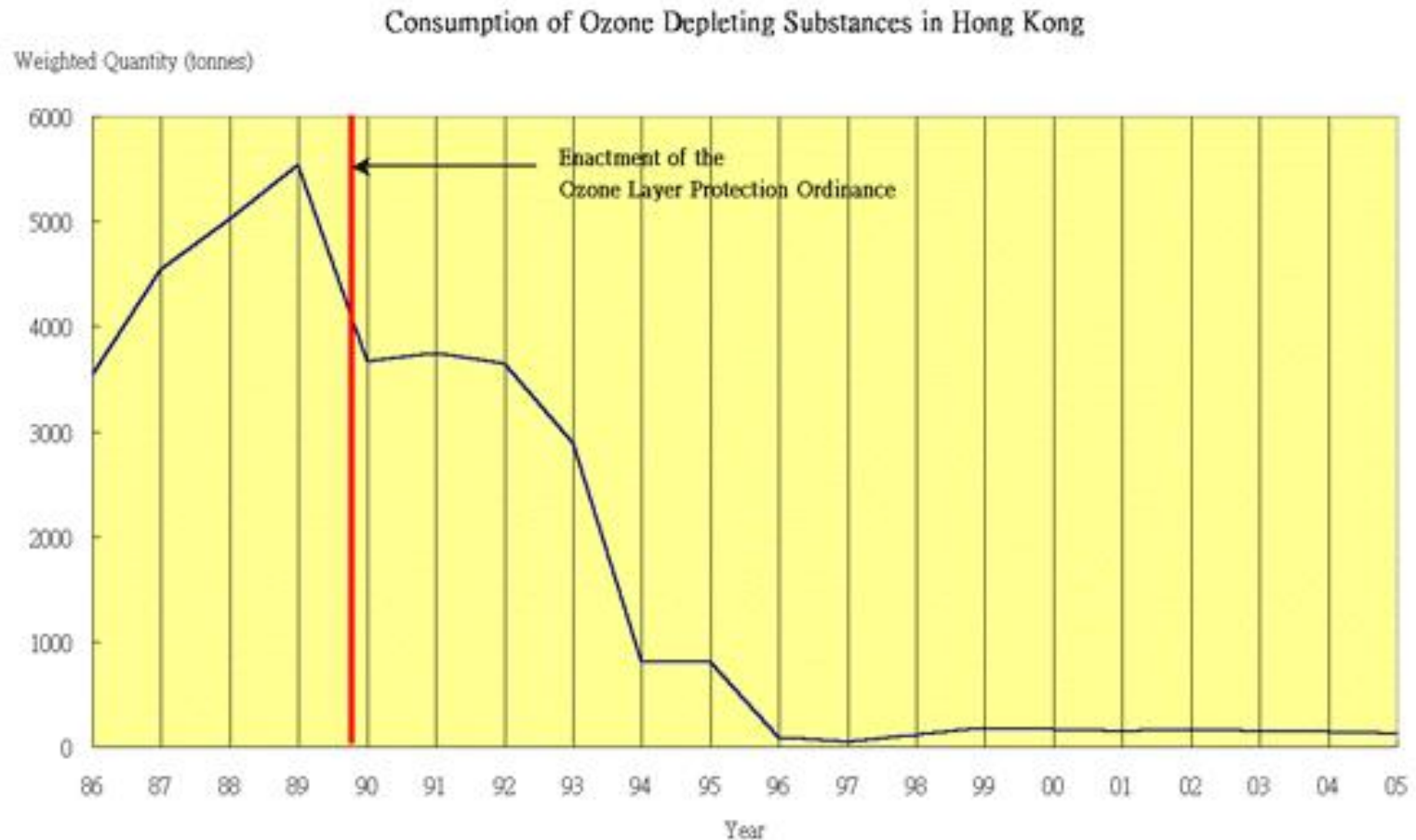
Source: Survey conducted by EPD, The Government of HKSAR in 2000

History - Halon



Source: EDP, The Government of HKSAR, Report on Halon Usage, 2000

Ozone Depleting Substance in Hong Kong



Source: The Government of HKSAR, EDP Report "Phasing Out of Ozone Depleting Substances in Hong Kong"
http://www.epd.gov.hk/epd/english/environmentinhk/air/data/phase_out.htm

Novec

Novec

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3M™ Novec™ 1230 Fire Protection Fluid

Typical Physical Properties (Not for specification purposes)

Chemical formula	$\text{CF}_3\text{CF}_2\text{C}(\text{O})\text{CF}(\text{CF}_3)_2$
Molecular weight	316.04
Boiling point @ 1 atm	49.2°C (120.6°F)
Freezing point	-108°C (-162.4°F)
Density, sat. liquid, 25°C	1.60 g/ml (99.9 lbm/ft ³)
Density, gas @ 1 atm, 25°C	0.0136 g/ml (0.851 lbm/ft ³)
Specific volume @ 1 atm, 25°C	0.0733 m ³ /kg (1.175 ft ³ /lb)
Liquid viscosity @ 0°C/25°C	0.56/0.39 centistokes
Heat of vaporization @ BP	88.0 kJ/kg (37.9 BTU/lb)
Solubility of H ₂ O in Novec 1230 fluid	<0.001% by wt.
Vapor pressure @ 25°C	0.404 bar (5.87 psig)
Relative dielectric strength @ 1 atm (N ₂ =1.0)	2.3

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Liquid to Vapor



Storage Requirement

FM-200 - Windows Internet Explorer

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FM-200

Page Tools

Novec 1230

CHEMETRON
Fire Systems
A World of Protection

Fast & Efficient Performance
Compact storage space requirements

FM200 / Novec	
Halon	
CO₂	
Inert Gas	

start

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2 Microsoft Pow...

Gas Flooding syste...

7 Internet Explorer

Address 100%

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Criteria of Selecting Gas Extinguishing Agency

Government	Acting as pilot
Public Utilities	Existing systems (Delaying) New systems (Halon alternative)
Private Sector	Existing systems (Delaying / doing nothing) New systems (Halon alternative)

Gas Extinguishing System Strategy

New Buildings	New gas extinguishing system
Existing Buildings	Replacement 25%
	Recycling
	Do nothing
	Delaying

Novec 1230

NOVEC 1230 - Windows Internet Explorer

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NOVEC 1230

Yahool Search

Home Print Page Tools

CHEMETRON
Fire Systems
A World of Protection

NOVEC 1230

NOVEC 1230 History

- ◆ 1999
 - Molecule discovered
 - Patent filed
 - Initial chemical characterization completed
- ◆ 2000
 - First manufactured in test quantities
 - Initial toxicity screening testing performed
 - Fire performance established
 - Compatibility testing initiated

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Novec 1230

NOVEC 1230 - Windows Internet Explorer

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NOVEC 1230

NOVEC 1230

CHEMETRON
Fire Systems
A World of Protection

History continued

- ◆ 2001
 - Accepted to the US EPA SNAP List
 - Toxicity testing - cardiac sensitization, LC-50, completed
 - Fire performance established – total flooding
 - Patent filing published, molecule disclosed
 - Commercial quantities first manufactured
- ◆ 2002
 - UL/FM fire testing completed
 - First systems sales, 2-1/2 years from discovery

start | I Fire E | My Computer | Microsoft Pow... | NOVEC 1230 - ... | Address | 84% | 9:08 PM

Approvals

The screenshot shows a Windows Internet Explorer browser window. The title bar reads "NOVEC 1230 - Windows Internet Explorer". The address bar shows the file path "D:\HTML\Novec\036.htm". The page content includes a header with "NOVEC 1230" and the "CHEMETRON Fire Systems" logo with the tagline "A World of Protection". The main heading is "NOVEC 1230 Listings & Approvals". Below this is a table with two columns: "Approval Authority" and "Status".

Approval Authority	Status
UL Listing	Completed
FM Approvals	Completed
ULC Listing	Completed
US Coast Guard	Pending

The Windows taskbar at the bottom shows the Start button, several icons, and open applications including "I Fire E", "My Computer", "Microsoft Pow...", and "NOVEC 1230 - ...". The system tray on the right shows a battery level of 84% and the time 9:08 PM.

Components

NOVEC 1230 - Windows Internet Explorer

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NOVEC 1230

Yahool Search

Page Tools

NOVEC 1230

CHEMETRON
Fire Systems
A World of Protection

Sigma Hardware

Cylinder Sizes

- 600 lb (300 to 600 lbs)
(136.1 to 272.2 kg)
- 750 lb (450 to 800 lbs)
(204.1 to 363.0 kg)
- 1000 lb (700 to 1000 lbs)
(317.6 to 453.6 kg)



10/25/2005

start I Fire E My Computer Microsoft Pow... NOVEC 1230 -... Address 82%

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NOAEL

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3M™ Novec™ 1230 Fire Protection Fluid Safety Margin

Agent	Novec 1230	Halon 1301	HFC-125	HFC-227ea
Use Concentration	4-6%	5%	8.7-12.1%	7.5-8.7%
NOAEL ³	10% ⁴	5%	7.5%	9%
Safety Margin	67-150%	Nil	Nil	3-20%

³ NOAEL for cardiac sensitization.
⁴ NOAEL for acute toxicity, including cardiac sensitization.

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Environmental Safety

NOVEC 1230 - Windows Internet Explorer

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NOVEC 1230

NOVEC 1230

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Fire Systems
A World of Protection

Environmental Factors Effecting the Fire Protection Industry

- ◆ Not effected by Montreal Protocol
The Montreal Protocol directed the reduction of Ozone Depleting chemicals.
Zero Ozone Depletion Potential
- ◆ Not effected by Kyoto Protocol
Very low GWP / Short atmospheric lifetime

The closest alternative is 33 years

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Environmental Properties

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Save a Copy Search Select 200% Help Search Web Capture, Share, Review 3D Designs

3M™ Novec™ 1230 Fire Protection Fluid Environmental Properties

Properties	Novec 1230	Halon 1211	Halon 1301	HFC-125	HFC-227ea
Ozone Depletion Potential (ODP) ¹	0.0	5.1	12.0	0.0	0.0
Global Warming Potential ²	1	1300	6900	3400	3500
Atmospheric Lifetime (Years)	0.014	11	65	29	33
SNAP (Yes/No)	Yes	N/A	N/A	Yes	Yes

¹ World Meteorological Organization (WMO) 1998, Model-Derived Method.
² Intergovernmental Panel on Climate Change (IPCC) 2001 Method, 100 Year ITH.

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Global Warming Potential

GWP of Various Compounds

Compound	GWP (100 Yr ITH)
CO ₂	1
N ₂ O	296
CH ₄	23
CF ₃ CH ₂ F (HFC-134a)	1,300
CF ₃ CFHCF ₃ (HFC-227ea)	3,500
CF ₃ H (HFC-23)	12,000
C ₂ F ₆	11,900
C ₃ F ₈ , C ₄ F ₁₀ , C ₆ F ₁₄	8,600 - 9,000
SF ₆	22,200
C ₄ F ₉ OCH ₃ (HFE-7100)	320
C ₄ F ₉ OC ₂ H ₅ (HFE-7200)	55
C ₂ F ₅ C(O)CF(CF ₃) ₂	1

Naturally occurring compounds

HFCs

PFCs

HFEs

Novec 1230 fluid

NEXT

BACK

PREV

DOCS.

3M Novec™ 1230
Fire Protection Fluid

Novec as Liquid



Relative Cost of Gas Extinguishing Agency

Type of System	Weight of Agency	Cost of Agency	System total cost
Halon 1301	1	1	1
HFC 227ea	1.6	3.2	3
Inert Gas	10	0.3	3.9
CO ₂	4	0.15	1.9
Novec	2	4.2	4

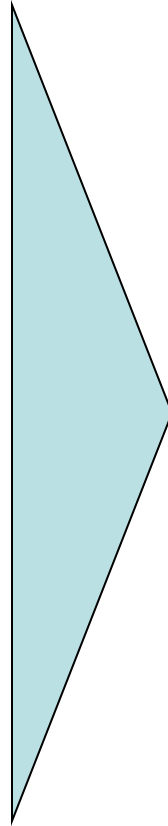
Reference: The estimate is based on 500m³ enclosure as specified by NFPA2001

Charging



Conclusion

Halon 1301



Halon
Replacement

= Novec ?

1. Cost?
2. Safety?
3. Extinguishing Effectiveness?
4. Environmental Impact?