

**HALON 1211/1301 REPLACEMENT PROGRAM  
STATUS: U.S. AIR FORCE GROUND BASED  
FIRE SUPPRESSION APPLICATIONS**

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# WL/FIVCF

## HALON REPLACEMENT PROGRAM

### OBJECTIVE

- Identify or develop replacement agents for Halon 1211 and Halon 1301 that are non-toxic and that have low to zero ozone depletion and global warming potentials

### TECHNICAL APPROACH

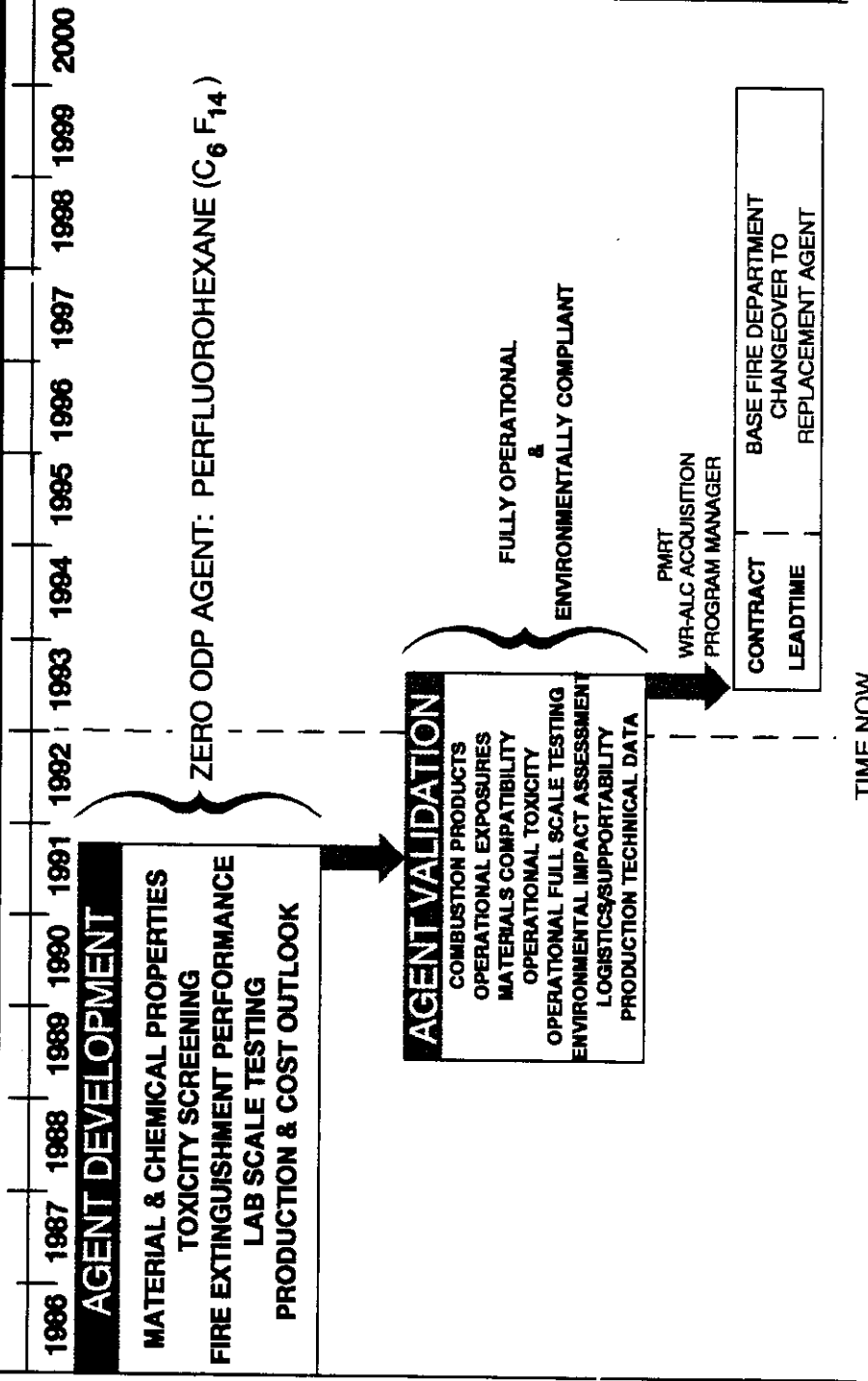
- Conduct laboratory and small scale tests of available candidate chemicals
- Down select to most promising candidates and conduct medium to large scale tests to validate one or more chemicals
- Down select to most promising candidates to qualify chemical for USAF use

### PAYOFF

- Provide USAF firefighter with environmentally safe, non-toxic, clean fire suppression agents
- Meet AFR 19-15 requirement to cease use of halons by 1 Jan 2000

# WLF/FINCF

## HALON 1211 REPLACEMENT AGENT RESEARCH & VALIDATION PROGRAM



AFR 19-15 TOTAL  
USE PHASEOUT DATE:  
1 JAN 2000

# WL/FIVCF

## 6.2 R&D RESULTS

	TOXICITY LC <sub>50</sub>	EXTINGUISHMENT % TOTAL FLOOD	ODP	PRODUCTION	COST
HALON 1211	12.8%	3.2	3.0	FULLY AVAILABLE	\$10.95/LB
HCFC-124	21%	8.2	0.02	AVAILABLE 1992-93	EST \$4.50/LB
HCFC-123	3%	6.3	0.02	AVAILABLE LATE 1991	EST \$4.50/LB
PERFLUORO HEXANE (C <sub>6</sub> F <sub>14</sub> )	> 30%	4.4	0.00	CURRENTLY IN PRODUCTION	EST \$9/LB

\* - \$3.00 COST + \$7.95 TAX PENALTY STARTING 1994

### LIVE FIRE TESTS

- CUP BURNER APPARATUS
- LAB SMALL PANS  
4 SF  
32 SF
- 75 & 150 SF POOL FIRES
- 3-D ENGINE NACELLE  
W/FLOWING FUEL COLUMN  
INTO 75 SF POOL FIRE

### PERFLUOROHEXANE PROPERTIES

- HEAVY MOLECULE CHEMICAL, HIGH ENERGY ABSORBER
- CHEMICALLY INERT - VERY LOW TOXICITY
- STABLE, NON-REACTIVE, ELECTRICALLY NON-CONDUCTIVE
- LEAVES NO RESIDUE AFTER FIRE EXTINGUISHMENT
- LIQUID DENSITY = 1.68, LONG STREAM RANGE
- TRANSPORTABLE - NO SPECIAL CONTAINMENT VESSEL REQ'D
- COMPATIBLE WITH ALL CURRENT EXTINGUISHER MATERIALS
- LONG ATMOSPHERIC LIFE

**HALON 1211 - PFC-614  
FIRE EXTINGUISHMENT PERFORMANCE COMPARISON**

**USN - 800 SF/250-GAL FIRE ON WATER W/150LB AMEREX**

	HALON 1211	PFC-614	TME/VOLUME EQUIVALENCY
EXTINGUISHMENT TIME (SEC)	13.2	27.7	2.1
AGENT USED (LB)	58.0	124.3	2.1
FLOW RATE (LB/SEC)	4.47	4.54	

**USAF - 250 SF/6-GALLON FIRE ON CONCRETE W/150 LB AMEREX**

	HALON 1211	PFC-614	TME/VOLUME EQUIVALENCY
EXTINGUISHMENT TIME (SEC)	6.0	6.0	1.0
AGENT USED (LB)	30.5	38.5	1.3
FLOW RATE (LB/SEC)	5.1	6.4	

**USAF - 3-D NACELLE FLOWING FUEL W/150LB AMEREX**

	HALON 1211	PFC-614	TME/VOLUME EQUIVALENCY
EXTINGUISHMENT TIME (SEC)	2.4	2.8	1.2
AGENT USED (LB)	20.3	28.0	1.4
FLOW RATE (LB/SEC)	8.4	9.7	

**USN - 72SF PAN FIRE ON WATER W/20 LB AMEREX**

	HALON 1211	PFC-614	TME/VOLUME EQUIVALENCY
EXTINGUISHMENT TIME (SEC)	5.0	12.2	2.4
AGENT USED (LB)	6.3	13.8	2.2
FLOW RATE (LB/SEC)	1.3	1.2	

**USN - DUAL NACELLE 3D FIRE W/20LB AMEREX**

	HALON 1211	PFC-614	TME/VOLUME EQUIVALENCY
EXTINGUISHMENT TIME (SEC)	1.8	2.8	1.6
AGENT USED (LB)	2.2	4.4	2.0
FLOW RATE (LB/SEC)	1.3	1.6	

C&COMP

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**HALON 1301 (FACILITIES)  
REPLACEMENT**

- **NEAR TERM PROGRAM (<3 YRS)**
- **2ND GENERATION AGENT DEVELOPMENT (10+ YRS)**
- **AEROSOL FIRE SUPPRESSION (ALTERNATE)**

# TOTAL-FLOOD AGENTS VS AIRCRAFT AGENTS REQUIREMENTS MATRIX FOR SCREENING

AREA OF CONCERN	TOTAL-FLOOD	AIRCRAFT
TOXICITY	<b>CRITICAL</b>	NOT CRITICAL
SPACE/WEIGHT	NOT CRITICAL	<b>CRITICAL</b>
GASEOUS	<b>CRITICAL</b>	<b>CRITICAL</b>
CLEAN/NON-CONDUCTIVE	<b>CRITICAL</b>	NOT CRITICAL
EXPLOSION SUPPRESSION	NOT CRITICAL	<b>CRITICAL</b>
COST	<b>CRITICAL</b>	NOT CRITICAL

# HALON 1301 REPLACEMENT AGENT PROGRAM FACILITY TOTAL FLOOD

	FY 92	FY 93	FY 94	FY 95	FY 96 - 99
6.2	110	600		400	
6.3A			800		

## AGENT DEVELOPMENT

MATERIAL & CHEMICAL PROPERTIES  
TOXICITY SCREENING  
FIRE EXTINGUISHMENT PERFORMANCE  
LAB SCALE TESTING  
PRODUCTION & COST OUTLOOK

CANDIDATE HALON 1301  
REPLACEMENT AGENTS

## AGENT VALIDATION

COMBUSTION PRODUCTS  
OPERATIONAL EXPOSURES  
MATERIALS COMPATIBILITY  
OPERATIONAL TOXICITY  
FULL SCALE EXTINGUISHMENT TESTING  
FACILITY SYSTEM FLOW COMPATIBILITY  
ENVIRONMENTAL IMPACT ASSESSMENT  
LOGISTICS/SUPPORTABILITY  
PURCHASE DESCRIPTION  
FACILITY SYSTEM SPECIFICATIONS

## MCP/O&M

FACILITY SYSTEM  
MODIFICATIONS &  
CHANGEOVER TO  
REPLACEMENT AGENT

- PROGRAM MANAGEMENT: CEL FIRE RESEARCH, TYNDALL AFB
- PROGRAM RISK:
  - TECHNICAL - MODERATE
  - SCHEDULE - MODERATE
  - SAT COST - LOW
- TECH TRANSFER: AGENT PURCHASE SPEC & FACILITY MOD CRITERIA TO AFCE



# CANDIDATE TOTAL-FLOOD AGENTS

BASED ON HALON 1211 REPLACEMENT DATABASE SCREENS

CHEMICAL	FORMULA	EXT CONC	LC50	ODP
HALON 1301	CF <sub>3</sub> Br	3-4 %	> 40 %	10
FC-218	CF <sub>3</sub> CF <sub>2</sub> CF <sub>3</sub>	6 %	very low toxicity	0
FC-116	CF <sub>3</sub> CF <sub>3</sub>	7.8 %	very low toxicity	0
C-318	(CF <sub>2</sub> ) <sub>4</sub>	7 %	very low toxicity	0
HFC-23	CHF <sub>3</sub>	13 %	> 65 %	0 DuPONT
HFC-125	CF <sub>3</sub> CHF <sub>2</sub>	9 %	> 70 %	0 DuPONT
FC-3-1-10	C <sub>4</sub> F <sub>10</sub>	5-6 %	> 80 %	0 3M
HFC-227ea	CF <sub>3</sub> CHF <sub>2</sub> CF <sub>3</sub>	6 %	> 80 %	0 GREAT LAKES
HCFC-123 HCFC-22 HCFC-124	BLEND	8 %	29 %	0.02 N. AMERICAN FIRE GUARDIAN

NO INDUSTRY

PROponents

YET

INDUSTRY  
CANDIDATES

