US Army PEO Aviation
Halon Replacement Program

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Overview

• PEO AVN HR IPT Overview
• Program Objectives
• RAH-66 Comanche
• AH-64 Apache
• CH-47 Chinook
  – Ground Test
  – Flight Test
Program Overview

- Army policy – Eliminate ODC Dependency
- PEO Aviation sponsored
  - Inviting all relevant stakeholders from onset
    - All Army Aviation PMs
    - Aviation Engineering Directorate (AED)
    - 46th Test Wing (Wright Patt AFB)
    - US Army Center for Health Promotion and Preventative Medicine (CHPPM)
    - Assistant Sec Army Acq Log Tech ASA (ALT)
    - Manufacturers – Boeing, Sikorsky
Program Objectives

• Initial goals
  • Identify 1 common agent for all Army aviation systems
  • Minimize weight increase
  • Minimize cost
  • Minimize GWP/ODP

• 3 Phase fire and concentration tests
3 Phase Program

• Phase I –
  • Industry wide agent search,
    – HFC 125, CF3I, Novac 1230, HFE 7100, SPGG, HFE
  • Limited fire testing in generic simulator
    – Evaluate effectiveness at extreme temperatures
  • Aerojet review of SPGG and HFE
  • Cursory toxicity screen & material compatibility
  • Design and fabricate system simulator
  • Initial down select to phase II agents
Phase II

• Full testing of agents from Phase I
  – HFC 125, SPGG, SPGG Hybrid
  – Rotorcraft specific nacelle and airflows
  – Hot surfaces to actual engine temps
• Material compatibility coupon testing
• Toxicity study – No testing
• Down select to 1 common agent
• Independent Review Committee
  – NAVAIR, NIST, Boeing, Army IPT
• HFC – 125 selected as single agent
HFC -125 Selection

- Other agents possibly more effective but greater overall cost
- CF3I
  - Significant toxicity testing
  - Final approval - Uphill battle
- SPGG & Hybrid
  - Did not show weight saving over 125
- Active agent SPGG not tested
Comanche

- 0 and 160 flight conditions
- Hot and cold temp
- Initial concentrations required over 6 pounds of agent
- System design and optimization
  - Discharge nozzle design
  - 600 and 800 psi bottle pressure
- Final agent weight 3.25
Apache

• Fire Testing
  – Designed and built engine and nacelle simulator
  – Approximately 10lb/sec airflow
  – 3 initial fire locations
  – 3 out of 3 – no re-lights

• Concentration testing
  – 28 – 33% concentration required
Chinook

• Limited to Concentration testing
  – Fire test impractical
    • Unable to determine airflow dynamics
      – Large screened openings in cowlings for cooling
      – Numerous flow sources – bleed band, rotor tip vortices'
    • Impractical to build simulator able to replicate actual conditions
      – Concentration testing
  • 2 Phase – Ground and Flight Test
Chinook

• Concentration testing
  – Based on TDP Equations
    • 26% concentration required to extinguish fires
    • 6 pound HFC – 125 required to achieve 26%
  – Current system designed for 3 pounds of halon
  – Limited redesign required to accommodate increased agent
Chinook, System Redesign

- Bread Board Testing
  - Conducted at Pacific Scientific to determine plumbing size required for 6 – 8 lbs of 125
  - Maximum discharge time 1 second
  - Enlarge plumbing to 1 in. with varying size ends.
Chinook

• Ground test
  – Replicate conditions in 1969 Boeing study
  – Engines power - 92% n1
  – Discharge sequence – simulated normal EPs
    • Power Control lever off
    • 2 Second delay
    • Bottle discharge
  – Engine speed 60% n1 at discharge
  – System optimization
"% VOLUMETRIC CONCENTRATION vs. TIME
CH47 WITH ENGINE ON AT SEA LEVEL. DISCHARGE TEST WITH 8LBS HFC-125
Pacsci Test No. V306  Date: March 16, 2006"

TIME (SECONDS)
"% VOLUMETRIC CONCENTRATION vs. TIME

CH47 with engine on at sea level. Discharge test with 8 lbs HFC-125
Pacsci Test No. V314   Date: March 21, 2006"
"% VOLUMETRIC CONCENTRATION vs. TIME
CH47 WITH ENGINE ON AT SEA LEVEL. DISCHARGE TEST WITH 8LBS HFC-125
Pacsci Test No. V355 Date: May. 02, 2006"
Path Forward

• Further work on distribution system needed
• Research on internal modification to maintain concentration levels
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