U.S. ARMY AVIATION HALON REPLACEMENT PROGRAM FOR ROTORCRAFT ENGINE NACELLE FIRE PROTECTION

Scott J. Silies

PEO Aviation, Comanche Program Manager's Office
Redstone Arsenal, AL 35898
Tel: 256-313-4471
Scott.Silies@comanche.redstone.army.mil

Halon 1301 is the fire-extinguishing agent currently used by the U.S. Army for rotorcraft engine nacelle fire protection. In the early 1990s, the implementation of the Montreal Protocol, Clean Air Act, and Presidential Executive Orders stopping further Halon production, led the Department of Defense (DOD) to invoke policies requiring environmentally acceptable Halon replacements. DOD policy requires that the Army field the new RAH-66 Comanche aircraft with an environmentally acceptable Halon replacement.

The U.S. Army's Program Executive Office (PEO) for Aviation, in conjunction with the 46th Test Wing at Wright Patterson Air Force Base (WPAFB) have developed a test program for the replacement of Halon in Army rotary winged aircraft. This program includes building simulators at WPAFB for each aircraft engine nacelle, building and extinguishing fires, measuring agent concentrations in each simulator, and optimizing distribution systems for the agent/system chosen to replace Halon.

Because the Comanche aircraft has the most urgent need for a Halon alternative, the Comanche nacelle simulator was the first one constructed. Phase I testing, conducted in the 46th Test Wing's universal simulator, consisted of testing three high boiling point agents (HFE7100, Novec 1230, and CF3I) to determine suitability in cold temperature conditions. Several varieties of Solid Propellant Gas Generators (SPGGs) and hybrid SPGGs (utilizes an inert SPGG to propel a liquid agent) were also evaluated during this phase.

Results of phase I testing revealed that HFE7100 and Novec 1230 required large agent masses to extinguish fires at low temperatures (-40F). CF3I performed surprisingly well at low temperatures given the high boiling point of this agent. Testing with the gas generator devices during this phase appeared promising from a weight and performance standpoint. Because the Comanche aircraft is a Reconnaisance/Attack helicopter, a lightweight halon replacement is deemed essential for performance of the aircraft.

Leveraging off of previous testing, the Army had pre-selected the agent HFC-125 for phase II testing. Of the agents discussed above, it was decided only to carry two of the gas generator devices forward into phase II testing. Although CF3I appeared to be a very promising fire extinguishing agent, the Army decided that risk associated with toxicity issues outweighed performance benefits. After review of the phase I SPGG data, the Army decided that an inert SPGG and a hybrid SPGG using FM200 as its liquid agent would be carried into phase II. Although a chemically active SPGG showed promising phase I results, problems associated with qualification of these devices precluded further testing. The purpose of phase II testing would be to narrow this field of agents to one. This agent would then be carried forward to phase III where the distribution system for the agent would be optimized for inclusion into the aircraft.

Phase II testing began shortly after construction of the Comanche engine nacelle simulator (Figure 1) was completed.

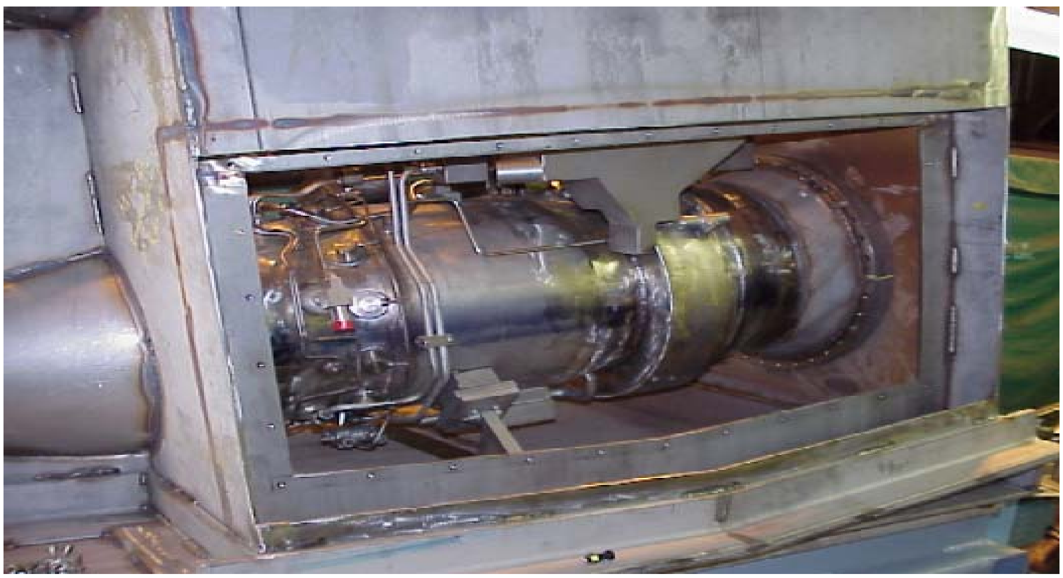

Figure 1. Inboard side view of Comanche engine nacelle simulator

It was evident from the start, that fire extinguishing inside the Comanche nacelle would be a great challenge due to a very complex airflow situation involving reverse flows at the high-speed forward flight condition.

Spray fires in various locations were used to determine a “Halon baseline”. Baseline test conditions were used to press Halon 1301 (at 6% concentration for ½ second) to its performance limits. Baseline fires that the alternate agents would have to extinguish were based upon the fire conditions that Halon 1301 could just extinguish. After completing the “Halon baseline” testing, the alternate agent testing began. Surprisingly, the gas generator devices did not perform as well as expected in the phase II testing. Results with these devices were inconsistent. Although the agent mass of HFC-125 required to consistently extinguish baseline fires was greater than desired, it became the obvious choice to carry forward into phase III testing.

Phase III testing would begin by determining the concentration of HFC-125 required to extinguish the baseline fires from phase II. Then, the agent distribution system would be optimized to try to meet the concentration requirements throughout the nacelle with the smallest amount of agent. At the time of writing this abstract, the Army is in the middle of phase III testing. Completion of phase III Comanche work is expected by the end of calendar year 2003.