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FRCSE locates potential fuel leaks with earth-friendly technology

121001-N-UL949-005 JACKSONVILLE, Fla. (Oct. 1, 2012) P-3 Fleet Support Team Engineer Dan Marlow (from left), Environmental Logistics Engineer Tom Cowherd, Chemist Kellie Carney, then P-3 Production Line General Foreman Greg Wallace and Production Support Specialist Rodney Boone pose before a P-3C Orion Maritime Patrol and Reconnaissance aircraft at Fleet Readiness Center Southeast (FRCSE). They led the team that implemented hydrogen leak detection technology at FRCSE to drastically reduce fuel leaks in P-3 fuel tanks and improve turnaround time to the Fleet. (U.S. Navy photo/Released)

JACKSONVILLE, Fla. – Fleet Readiness Center Southeast (FRCSE) is utilizing effective, environmentally-friendly technology to locate potential fuel leaks on the Navy's P-3 Orion Maritime Patrol aircraft in response to stricter federal regulations and standards for gas leak detection.

FRCSE artisans are using hydrogen leak detection to identify leaks in fuel tanks as a replacement for Chloro-Fluoro Carbon (CFC) 113, an ozone depleting substance that was banned in 1996.

"Prior to 1996, CFC-113 was the principal method used to locate potential fuel leaks in aviation fuel tanks," said Tom Cowherd, a logistics engineer and pollution prevention manager.

Cowherd said pressure decay testing continues to be the Navy's primary method to prove the integrity of fuel tanks; however, it is inadequate for locating specific leaks to be repaired.

"A fuel tank or cell is pressurized with air and then the pressure source is isolated," he said. "A pressure gage is monitored for pressure drop. Zero drop over a specified time period corrected for tank volume and ambient temperature change is the 'go-no-go' criteria for acceptance."

A quick pressure drop indicates the presence of a large leak. A slow pressure drop over time indicates a small leak. In either case, a soapy solution is then applied to the outer tank surface to locate the source. Escaping air or the formation of air bubbles indicates a leak.

After repairs are completed, artisans again perform the pressure drop test to ensure all leaks have been sealed. Unfortunately, fuel leaks frequently occur at levels well below the point of soap bubble formation and are a common reason for a failed pressure drop test.

Since the ban of CFC-113, existing methods of fuel leak detection have not proven adequate to identify all potential fuel leaks nor ensure the integrity of fuel systems. The result is frequent, unnecessary rework and retest of fuel tanks.

"Identifying and repairing fuel leaks continues to be a significant issue that regularly impacts maintenance and repair schedules," said Cowherd. "Small fuel leaks continue to have a strong potential to down critical Navy assets and impact Fleet readiness."

Additionally, rework due to leaks increases personnel exposures to fuel, is costly and causes harm to the environment if leaks go undetected or if fuel is not properly contained on airfields.

Since 2007, the Navy Environmental Sustainability Development to Integration (NESDI) program has supported FRCSE with investigating alternative fuel leak detection technologies and restoring capabilities lost with the ban of CFC-113.

Subsequently, commercial leak detection technologies have advanced and a variety of potential alternatives are available including ultrasonic and infrared thermography, and several trace gas leak detection technologies, the most promising being hydrogen and helium leak detection.

In collaboration with the U.S. Air Force, FRCSE and commercial vendors conducted technology demonstrations on several P-3 wing tanks and determined the hydrogen trace gas technology was more user-friendly, accurate and reliable than the helium trace gas technology. Further, the hydrogen technology was less costly, and the gas more readily available than helium, a limited resource.

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Hydrogen leak detection technology uses a 95 percent nitrogen to 5 percent hydrogen mix trace gas that is non-flammable and inherently safe. The hydrogen trace gas is injected into the empty (sealed) fuel tank, and the external tank surface is probed with the portable detector to find and locate leaks. When detected, the unit provides a visual LED light and audible alarm.

The hydrogen leak detector uses a "sniffer" probe that has the capability to detect extremely small leaks. The P-3 Fleet Support Team (FST) established a threshold to identify the smallest opening with the potential for leaking fuel. To validate, the team performed several tests on multiple P-3 aircraft and verified that no fuel leaks were observed during initial wet check/fueling operations.

"A pressure decay test determines the presence of a fuel leak but not the location," said Kellie Carney, an FRCSE chemist and author of Local Process Specification (LPS) 1640 that eliminates more than half of the leak detection process steps while saving time and money. "If a leak is discovered, artisans can use hydrogen leak detection to pinpoint the source and size of the leak. The sniffer probe is very sensitive and can detect very small concentrations of gas; however, it doesn't necessarily indicate the fuel will leak."

Carney said the P-3 program's success was in part due to the efforts of Bryan Swafford and Jason Jones, both sheet metal mechanics who received trace gas detection training from the vendor in March 2012.

"We have taught them the science," said Carney, "but they know the aircraft and that knowledge gives them a leg up on interpreting the readings. It is as much a science as it is an art."

FRCSE engineering is working to get approval for the 'backflow leak detection" method used to locate the source of P-3 wing tank fuel leaks. Artisans know that a fuel leak found on the outside of the tank does not always identify the origin of the leak. By applying the trace gas through an injection pad on the outside and using the hydrogen leak detector on the inside of the tank, artisans are identifying and repairing leaks that are frequently masked by seam sealers and paints.

Through these efforts, FRCSE has substantially reduced potential hazardous waste streams associated with aviation fuel tank repair and leak testing, and the risk associated with potential water runoff contamination due to leaking aircraft fuel tanks on maintenance airfields.

To date, FRCSE has reported a 15 percent reduction in P-3 turnaround time and realized a cost avoidance of nearly $20,000 per aircraft.

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121001-N-UL949-003 JACKSONVILLE, Fla. (Oct. 1, 2012) Sheet Metal Mechanic Bryan Swafford inspects a P-3 Orion wing tank for potential fuel leaks using hydrogen leak detection technology at Fleet Readiness Center Southeast (FRCSE). During Fiscal Year 2012, FRCSE established the new leak detection capability for the P-3 aircraft that has reduced the turnaround time of aircraft wet check by 15 percent and provided a cost avoidance of nearly $20,000 per aircraft. Chemist Kellie Carney with Materials Engineering and Engineer Dan Marlowe, along with the P-3 Fleet Support Team implemented the process that employs 5 percent hydrogen and 95 percent nitrogen trace gas. This technology restores the fuel leak detection capability lost with the banning of Chloro-Fluoro Carbon (CFC) 113 in 1996. (U.S. Navy photo/Released)