Navy Leaders Describe Efforts to Resolve Physiological Episodes

U.S. Navy photos by Emanuel Cavallaro

By Emanuel Cavallaro

At the 61st annual Tailhook Convention, U.S. Navy leaders and experts outlined the Naval Aviation Enterprise's ongoing efforts to address challenges to readiness.

http://navalaviationnews.navylive.dodlive.mil/files/2017/12/NAN-Fall2017_web.pdf

"Readiness is our No. 1 priority, and right behind that—our No. 1 safety priority—is solving the physiological episodes," Vice Adm. Mike Shoemaker, commander, Naval Air Forces, told his audience during the convention's final panel discussion Sept. 9.

During a safety discussion panel the previous day, moderator Rear Adm. Scott Dillon, commander, Naval Safety Center, said the center is supporting physiological episode (PE) mitigation efforts by "more effectively and more quickly providing feedback to the fleet as individual episodes are investigated."

"We took a step in that direction in 2017 by participating in six physiological episode briefings across fleet concentration areas," Dillon said. "And we have more plans in place for how we're going to increase the feedback that we provide the fleet."

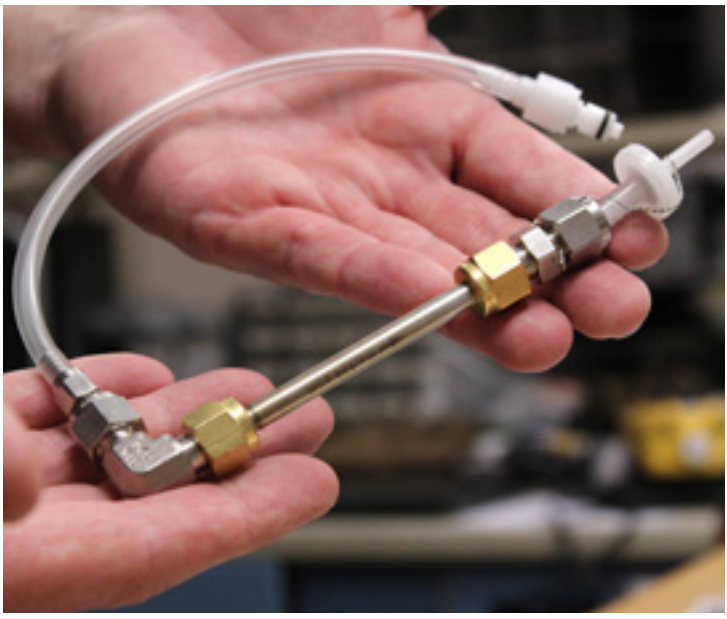
A physiological episode occurs when aircrew experience dizziness or loss of consciousness due to cabin environmental effects, contamination of breathing air or other factors in the flight environment.

The Naval Safety Center has a Physiological Event Rapid Response Team that can react quickly to an episode when it occurs, Dillon said. The team collects information about the episode in much the same way an Aircraft Mishap Board would during a mishap investigation.

The center's staff then sends that information to aeromedical professionals, engineers and other experts who are working to determine the causes of these episodes.

Also on the panel was Rear Adm. (sel) Sara A. Joyner, the lead for the Physiological Episode Action Team, which was tasked this year to collect data, investigate occurrences of physiological episodes and coordinate with technical experts to identify and develop solutions based on root cause determinations of PEs.

The Naval Air Warfare Center Aircraft Division Altitude Lab uses these mechanical breathing machines to simulate aircrew breathing while testing oxygen systems, such as the On-board Oxygen Generation Systems (OBOGS).



The above sorbent tube is a reusable metal tube that attaches to the aircrew's oxygen breathing regulator and is used to sample the oxygen flow for potential contaminants. These samples allow engineers to monitor and assess the quality of the breathing gas that was delivered to aircrew during flight.

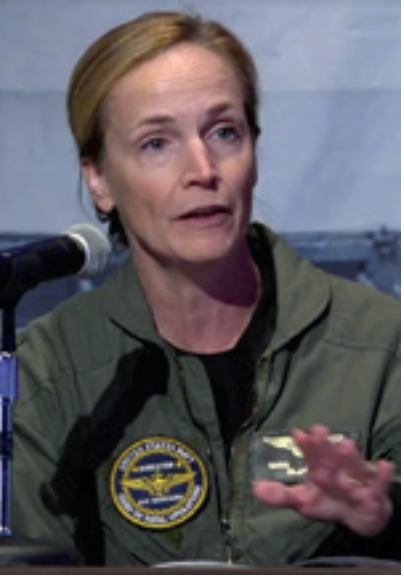
Joyner's team combines personnel and resources from Naval Air Systems Command, Naval Air Forces, and the fleet with submarine officers and top Navy engineers, physiologists and data scientists.

In the beginning of their review of PEs, Joyner said, she had been confident her team might find a single solution, but she quickly realized that the problem is complex and going down one path could limit discovery and success. Physiological episodes occur in every type of airframe, she noted. The issue isn't limited to a specific aircraft; it can arise whenever a human is placed in a pressurized environment and fed oxygen.

"If you want to jump to a conclusion when looking at the PE incidences, you're liable to cause an adverse outcome," she said, noting lessons from the U.S. Air Force's efforts to address the same issue in the F-22 Raptor.

"The Air Force shared their lessons

The emergency oxygen cylinder is located in the ejection seat. It holds about 200 liters of high pressure gaseous oxygen used during an ejection and as an emergency backup to the OBOGS.



learned, and we are benefitting from their experiences as we move to resolve PEs," Joyner said.

The Physiological Episode Action Team is taking a multi-cockpit, multi-airframe approach to the issue, Joyner said. Their goals are to establish near-term, mid-term and long-term solutions by methodically examining the factors using root-cause corrective action, the same methodical and data-driven approach the Air Force used.

In the near-term, Joyner's team is devising best practices and procedures that will mitigate the problem, while aggressively burning down risk and enhancing flight safety.

"We test [practices and procedures], we verify, and then we field them," she said.

Realizing that physiological episodes are particularly dangerous because of their "unwarned nature," Joyner's team also has been working to identify signs that can be used to provide indications to a pilot before an episode to allow the aircrew time to initiate pre-planned emergency procedures and land the aircraft safely.

"We need to make sure those warnings and indications are inside the cockpit to reduce the risk to the pilot today," she said.

The team's efforts have involved physiologists examining the effects of different kinds of pressurization, as well as scientists examining data collected from an engineering tool called a Slam Stick, a sensor used in aircraft to record pressure changes.

The data indicates that the relationship between pressure changes is more complicated than a simple one-to-one correlation.

"When we looked at that [Slam Stick] data, we had 145 aviators experiencing a [significant] pressure fluctuation and maybe one of them having a PE," Joyner said.

Also speaking on the panel was Capt. David Kindley, program manager for the F/A-18 & EA-18G program office. In his remarks, Kindley split the problem into two

"I am committed to finding a solution, but our speed has to be tempered by a solution that doesn't adversely impact the human and aviation system. We ask a lot of our aircrew, and the aircraft they fly are highly complex and highly capable. We need to make sure both the person and the machine have what they need to successfully complete the mission."

—Rear Adm. (sel) Sara A. Joyner

U.S. Navy photo by Adam Skoczylas

Ed Gassie, assistant program manager for engineering, left, observes as John Krohn, a Naval Air Warfare Center Aircraft Division (NAWCAD) engineer, swabs the Environmental Control System supply line to the OBOGS concentrator inlet of a T-45 Goshawk in April to help determine the cause of physiological episodes.

U.S. Navy photo by A

Cyndi Wade, engineer with the T-45 fleet support team, right, assists NAWCAD engineer John Krohn as he collects samples from a T-45 Goshawk in April.

categories, the first being breathing gas—a lack of oxygen in the air, not enough air or something in the air that affects the pilot's ability to process the oxygen.

That was the major issue for F/A-18E-F Super Hornets about a year and a half ago, Kindley said. The Navy has been installing new "sieve beds" with a carbon monoxide catalyst to address the problem.

"It seems we are moving in the right direction with breathing gas issues," he said.

The second category he described is pressurization—over pressurization, depressurization or surging pressurization. Physiological episodes related to pressurization occur across all type/model/series, he said, but they show up most often in F/A-18A-D Hornets. Kindley expressed frustration with progress on this front.

A number of components in aircraft that are responsible for feeding air into and letting air out of the cockpit are susceptible to malfunction, he said. However, simply replacing one of these components by itself when it malfunctions with a new, better component doesn't always solve the problem. It is an entire system, influenced by a number of factors, and changing one part can affect the whole system.

Among the many strategies the Navy is exploring to address pressurization issues is a process called an Environmental Control System (ECS) reset, which involves replacing a number of components at the same time. The first part of an ECS reset calls for the replacement of the "big seven" components that have a higher likelihood to malfunction and can be replaced relatively quickly with parts on hand. "We think ECS reset will remove a significant chunk of the problem," Kindley said.

A more extensive ECS reset calls for the replacement of 30 components, representing what Kindley called a "significant effort" requiring on the order of 400 hours of work that must be executed not by squadron maintainers but by depot artisans, albeit on the flight line.

In the meantime, his team is pursuing Joyner's goal of providing near-term solutions for pilots by improving the altimeter, expanding the emergency oxygen bottle in the seat and changing the way the aircraft responds to certain inputs.

Ultimately, the long-term goal is to devise a system for the cockpit that will tell a pilot when something has gone awry with the cockpit's airflow or pressurization and initiate an automatic backup system, Kindley said.

"I am committed to finding a solution, but our speed has to be tempered by a solution that doesn't adversely impact the human and aviation system," Joyner said. "We ask a lot of our aircrew, and the aircraft they fly are highly complex and highly capable. We need to make sure both the person and the machine have what they need to successfully complete the mission."

Emanuel Cavallaro is a staff writer for Naval Air Systems Command Public Affairs.

Slam Stick Success

Integration of a Slam Stick data logger is one initiative in the Naval Aviation Enterprise's collect-and-analyze-data effort to address physiological episodes (PEs). Designed to measure and record vibrations, temperature and air pressure, the Navy is using the device to measure cabin pressure changes over time in F/A-18A-D Hornet, F/A-18E-F Super Hornet and EA-18G Growler aircraft. The small, lightweight sensor can be placed virtually anywhere in an aircraft. Its rugged enclosure and wide temperature operating range allow its use in tough environments.

U.S. Navy photo by Fred Flerlage