

Topic: N101-026

SAFE, Inc.

Multi-Axis Vibration Mitigation and Habitability Improvement for Seated Occupants

Safe's Multi-Axis Vibration Reduction for Increased Comfort (MAVRIC) aircraft seat has an electronically controlled suspension to protect Navy aircrew from chronic injuries caused by whole body vibration. The seat's ergonomic design also reduces discomfort and fatigue for extended mission endurance. Safe is an engineering firm with a core focus on safety and survivability; ongoing technology development in seats, armor, survival rafts, and restraints; and recent deliveries of spacecraft crew protection devices. The vibration damping technology can be used for any vehicle occupant subject to injury hazards from severe vibration exposure. The prototype MAVRIC Operator seat increased the duration of safe exposure 16-fold, and the Copilot seat is now entering testing. Safe seeks Navy support to fully qualify the seat and deploy it to the E-2C/D fleet.

### Technology Category Alignment:

Protection, Sustainment, and Warfighter Performance

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**SYSCOM:** NAVAIR

**Contract:** N68335-16-C-0385

 Corporate Brochure: [https://navystp.com/vtm/open\\_file?type=brochure&id=N68335-16-C-0385](https://navystp.com/vtm/open_file?type=brochure&id=N68335-16-C-0385)

Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2018-788

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WHO

**SYSCOM:** NAVAIR

**Sponsoring Program:** PMA-231 E-2/C-2 Airborne Tactical Data System Program Office

**Transition Target:** E-2C/D Hawkeye Operator and Pilot/Copilot Seats

**TPOC:**  
(301)342-8450

**Other transition opportunities:**  
C-2A Greyhound Pilot/Copilot Seats  
C-130 Hercules Pilot/Copilot Seats  
Other propeller driven and rotary wing aircraft  
Ground vehicle seat systems



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WHAT

**Operational Need and Improvement:** The E-2 Hawkeye is the Navy's all-weather airborne early warning and command and control aircraft for carrier battle groups. Seat improvements can help E-2 aircrew better endure extended mission lengths without experiencing fatigue and musculoskeletal pain. Seats must reduce exposure to whole body vibration while also providing ergonomic design features such as cushions that avoid pressure concentrations and adjustments for the backrest, armrest, headrest, and vertical and horizontal positions that accommodate the full range of occupant sizes while operating the aircraft.

**Specifications Required:** The primary requirement is a seat that isolates the occupant from whole body vibration and aligns exposure duration limits for vibration with mission lengths when assessed per the ISO-2631 standard. Other requirements include ensuring that the system weight is not substantially more than the current seat system; a design that can be installed without aircraft modifications; structural capability for specified crash and operational load cases; incorporation of features that eliminate or reduce pressure points on the body; adjustments for the backrest, headrest, armrest, and vertical and horizontal position that support ergonomic and mission needs, and compatibility with the existing body-worn mission equipment.

**Technology Developed:** Safe has developed the MAVRIC seat (Multi-Axis Vibration Reduction for Increased Comfort) with versions tailored for both the Operator and Pilot/Copilot positions. This highly-functional seating system meets both the operational need and the required specifications. The upper portion of the seat that supports the occupant is isolated from aircraft vibrations in all directions through magnetorheological (MR) vibration isolators. This system essentially creates an electronically-controlled suspension for the occupant to reduce the vibration exposure level. An ergonomic pan cushion reduces pressure concentration, and the seat has all of the adjustment features needed to operate the aircraft with improved mission endurance.

**Warfighter Value:** The MAVRIC seat's significant reduction in whole body vibration and improved ergonomics will increase aircrews' ability to conduct longer missions without developing numbness or pain in the back and legs. The result will be greater mission effectiveness and greater ability to sustain operational tempo.

WHEN

**Contract Number:** N68335-16-C-0385 **Ending on:** December 18, 2018

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Operator seat vibration test in laboratory	N/A	Vibration exposure limit 8 hours per ISO-2631	5	May 2014
Pilot/Copilot seat flight test in E-2C/D	Low	Crew acceptance and vibration exposure limit 7 hours per ISO-2631	6	December 2018
Operator seat flight test in E-2C/D	Med	Crew acceptance and vibration exposure limit 7 hours per ISO-2631	6	December 2018
Qualification test program completion	Med	Full compliance to all specifications	8	June 2021
Low rate initial production (LRIP)	Med	Commercialization strategy implemented	9	April 2022

HOW

**Projected Business Model:** The business model is for Safe to manufacture new seats incorporating integrated MR vibration isolators and associated electronic controller and sell to primes or directly to DOD to incorporate into aircraft or equipment platforms which have a need to mitigate whole body vibration and its short and long term adverse health effects. Safe has adequate manufacturing capacity to support rate production for initial sales from its existing facilities, and has demonstrated capability to deliver flight hardware on past projects. Estimated lead time is five months for delivery of MAVRIC seats from receipt of order. The seat has been designed for manufacturability and assembly and presents no significant hurdles to overcome in scaling to rate production.

**Company Objectives:** The objective for the Navy Forum is to develop relationships with the acquisition community and aircraft or vehicle primes interested in mitigating whole body vibration for occupants, with the E-2/C-2 program being of primary interest for supporting initial production. The company objectives are to obtain funding to refine the prototype MAVRIC seat design for minimum weight, fully qualify it against all requirements for flight (including functional, structural, climatic, electromagnetic, and software certification requirements), and transition seats into the fleet.

**Potential Commercial Applications:** The MAVRIC seat can help commercial fleet operators support the short term health and career longevity of their aircrew by reducing exposure to whole body vibration. This technology is most applicable to those propeller driven aircraft and rotary wing aircraft (helicopters) that have the most severe vibration environments. It can also be applied to ground vehicles. Examples of the potential commercial aviation market include the Embraer EMB-120, Bombardier Dash 8, ATR-72, Beechcraft 1900, Dornier 328, Fairchild Swearingen Metroliner, Saab 340, and Fokker 50 which are all driven by turboprop engines.

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