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PRESS RELEASE

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Spacecraft Leak Detection System Uses Surface-borne Ultrasonic Sensor Arrays

21 April 2008 – A Phase 2 Small Business Technology Transfer (STTR) proposal from Invocon, Inc. of Conroe, TX for a Spacecraft Leak Detection System was recently selected by NASA for contract negotiation. This technology development intends to provide a viable system to sense and locate air leaks from pressurized space station or lunar habitat modules caused by micrometeoroid and space debris impact events. The ability to detect, quickly locate, and mitigate a pressure vessel breach is critical to the safety of any long duration spacecraft.

The proposed approach uses low-cost ultrasonic sensor arrays developed by Invocon's research institution partner, Iowa State University. The team's proposal is to monitor the spacecraft structure itself -- the pressure vessel skin -- for leak-generated surface-borne ultrasound by means of a flexible and modular electronics package with fully integrated surface sensors, data acquisition electronics, and radio frequency communication capabilities.

Previous work by the university's Center for Nondestructive Evaluation has demonstrated the ability to utilize structure-borne ultrasound in the spacecraft skin for locating leaks to vacuum, even across multiple integral stiffeners, at low cost with minimal weight and size. Unlike most ultrasonic array sensors, this piezoelectric sensor design does not require a large number of channels of complicated pulse-generation or data acquisition electronics, but instead uses an integrated multiplexer to minimize the required electronics.

The sensor arrays are to be integrated with Invocon's battery-powered, miniaturized, "stick-on", ultrasonic sensory nodes that are all synchronized within a wireless network. Each node will measure only 4cm x 4cm x 2cm. The innovative signal conditioning circuit design is capable of operation in the micro-watt range on average while constantly maintaining the capability to process and acquire ultrasonic signals. Such performance can provide operating lifetimes of 10+ years on a single AA battery, or unlimited operation from scavenged power sources. Numbers of micro-sensor units developed by Invocon have already been flown on the Shuttle and International Space Station (ISS) to non-intrusively acquire valuable information on the performance and safety of various vehicle structures and systems.

Quickly and automatically locating a leak will not only improve the safety of the crew, but also increase the likelihood of being able to repair the leak, thereby avoiding the potential loss of a portion of the spacecraft or habitat. Through cooperation with nearby sensors, the leak detection system will determine the approximate location of the leak through triangulation techniques and provide that

information to the crew and ground controllers. The system is intended to provide a viable solution that can be installed easily and require minimal crew involvement.

Non-flight applications include a long-term, battery-operated, leak monitoring system for industrial and chemical facilities where either pressurized containers or vacuum facilities are utilized. The Department of Energy has identified compressed air leaks as a significant source of wasted energy and recommends incorporating a leak prevention program as part of facility operations. Commercial systems exist which are handheld and require the user to manually scan a suspect area, but pervasive monitoring systems could prove cost effective.

Invocon's core activities revolve around the design and manufacture of precision instrumentation and communication solutions for demanding applications in extreme environments. The company has developed electronic systems with a broad scope of applications - from underground to space, from military to commercial, from simple data recording to complex analysis, and from large-scale systems to miniature systems.