

# Department of the Navy SBIR/STTR Transition Program

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NAVSEA #

Topic # N181-049

Advanced Analyzers for Monitoring Submarine Atmosphere

Nikira Labs Inc.

## WHO

**SYSCOM:** NAVSEA

**Sponsoring Program:** Program Executive Office Columbia (PEO CLB)

**Transition Target:** Columbia-Class Submarines

**TPOC:**  
(215)897-7222

**Other transition opportunities:** The instrument can also be used to sense a wide array of chemical weapons. Thus, there are transition opportunities within the Defense Threat Reduction Agency (DTRA).



[https://www.navy.mil/view\\_image.asp?id=200120](https://www.navy.mil/view_image.asp?id=200120)

## WHAT

**Operational Need and Improvement:** US Naval submarines use a sophisticated array of generators, scrubbers, and burners to add oxygen, adsorb carbon dioxide, and remove air pollutants respectively to assure crew well-being. As new toxins are identified, current technologies are unable to measure them at the required limits due to sampling and instrument limitations. Thus, the USN needs innovative, novel analytical equipment to optimize air handling and increase sailor safety.

**Specifications Required:** The USN seeks new analytical technologies that can measure currently unmonitored species (e.g. acrolein, formaldehyde, ozone) without sample handling losses. The system must provide rapid (< 120 seconds) results with a low, annual cost of maintenance (< \$20,000). The latter represents a considerable cost savings relative to the current mass-spectrometer systems that require an average of \$145,000 in repair and overhaul costs every three years. The new analyzer should integrate into existing submarine air monitoring infrastructure.

**Technology Developed:** Nikira Labs Inc. is developing a novel, mid-infrared laser-based analyzer that measures a wide array of volatile compounds, including acrolein, formaldehyde, ozone, and many other species. The system uses a tunable quantum cascade laser coupled with cavity ringdown spectroscopy to measure the absorption spectra of submarine air. A sophisticated chemometric data analysis algorithm is then used to convert the measure spectrum to compound concentrations. By using cavity ringdown spectrometry, the system is able to detect trace (parts-per-billion) levels of many key toxins currently identified by the Navy.

**Warfighter Value:** The novel analyzer affords several advantages over current technology. Foremost, it provides trace detection of a host of toxins that cannot be measured by the current systems due to sampling and analyzer limitations. By scanning over a large spectral infrared spectral region (e.g. "fingerprint region"), the detector is able to measure hundreds of compounds simultaneously, allowing for submarine air monitors to readily adapt to changing needs. The system has no moving parts or vacuum pumps and instead operates at ambient pressure. Thus, service intervals are expected to exceed 6 years, with very minimal annual maintenance costs (< \$5k/year). The compact system can be integrated into the current centralized air monitoring cabinet and/or within a selected submarine compartment for distributed monitoring.

## WHEN

**Contract Number:** N68335-20-C-0072 **Ending on:** April 21, 2021

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Demonstrate that the technology is able to measure key USN compounds	N/A	Measure compounds in a laboratory setting	3	December 2019
Fabricate a prototype that meets fit, form, and function	Low	Fabricate the Phase II instrument (hardware, software, and electronic)	3	September 2020
Extensively laboratory test the prototype	Med	Meet Navy's analytical performance needs under laboratory conditions	3	December 2020
Test deploy the instrument aboard a Naval submarine	High	Measure volatile compounds aboard a submarine	6	March 2021

## HOW

**Projected Business Model:** Nikira Labs would like to team with a DoD prime contractor to help transition the technology to the fleet. We eventually anticipate serving as an OEM to the prime who will integrate the volatile compound analyzer into the submarine air monitoring system.

**Company Objectives:** Nikira Labs Inc. intends to use the STP forum to find numerous applications for our laser-based analytical solutions to current and evolving DoD problems. Our range of platform technologies can be utilized by many DoD branches that have air monitoring needs. Recently, we have subcontracted with Leidos, a DoD prime, to provide analyzers for high-power laser applications.

In the long term, Nikira Labs envisions providing a suite of optical solutions to a wide array of research, medical, and military customers.

**Potential Commercial Applications:** The technology can be used to measure many volatile compounds, including chemical weapons and medical breath diagnostics for DTRA and DARPA applications.

Beyond DoD, the volatile compound analyzer can be used for Superfund site monitoring and Department of Energy site toxin remediation efforts.

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