Department of the Navy SBIR/STTR Transition Program

DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited. ONR Approval #0543-1074-23 Topic # N202-131 Intelligent Laser System for CBM+ of Naval Platforms Axalume Inc.

WHO

SYSCOM: ONR

Sponsoring Program: None

Transition Target: TBD

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Other Transition Opportunities: All Naval and DoD platforms including ships, aircraft and land vehicles.

Notes: New Capability. A "Low Noise Tunable Laser System", which is just one part of a larger "Inteligent,

Fiber Optic Sensor System for System Health Management (SHM)" of Naval Platforms. With a few Al-controlled tunable lasers and hundreds of sensors and actuators, a health management system on a fiber provides for total platform coverage, with no ship electrical power requirements, and minimal man-in-the-loop requirements.

Axalume was established in 2017 with a mission to Develop Semiconductor Lasers & Electronic-Photonic Integrated Circuits. Background:

- Spinout from Oracle/Sun Microsystems

- SBIR contracts with US Navy, DARPA, and NSF

- Co-operative development grant with ARPA-E (DoE)
- 6 US patents granted (2 additional pending)
- Exclusive license to 200+ patents on photonics from Oracle

WHEN

Contract Number: N68335-22-C-0834

Ending on: Feb 02, 2024

| Milestone | Risk Level | Measure of Success | Ending TRL | Date |
|--|---------------|--|---------------|--------------------|
| Intelligent low-SWaP multiple laser system | Low | Capability demonstration with sensitivity measurements | 4 | 1st QTR FY24 |
| Intelligent low-SWaP multiple laser system Tunable lasers interrogating multiple distributed fiber sensors on a single fiber | Medium | Capability demonstration with sensitivity measurements | 4 | 2nd QTR FY24 |



Axalume SBIR proposal

WHAT

Operational Need and Improvement: 1. To monitor loads and temperature continuously from DC to MHz frequencies cycle-by-cycle.

2. To locate impact events and hot spots, to track damage initiation and progression, to help pre-position parts and optimize time and place of maintenance actions.

3. To triangulate high-fatigue areas, impact damage events, cracking, delamination, fretting.

- 4. To monitor the performance of repairs, composite patches, welded joints.
- 5. To lower the cost of ownership and accelerate the insertion of of new materials, structures, and parts.

Specifications Required: Multiple low-cost, low-Space Weight and Power (SWaP) tunable lasers and controllers monitoring 100's of sensors in a distributed fiber optic sensor system. This laser system will be a tunable, high sensitivity and low noise (Signal/Noise > 100 femto-strain/sqrt (Hz) in the frequency range from 10 kHz – 1 MHz). The system will provide small SWaP, unobtrusive technology with active-passive monitoring and will advance the state of the art in Fiber Optic (FO) sensors.

Technology Developed: Intelligent laser system for powering, sensing, and communicating between a centralized health management unit and acoustic emissions sensors on a platform-wide distributed fiber optic network for Condition Based Maintenance Plus (CBM) of Naval platforms.

Warfighter Value: The Intelligent Laser System will be a crucial part of a fiber optic based CBM approach and will reduce or eliminate the need for the complex, wired, and electrically powered health monitoring systems currently in use. A laser FO sensor CBM will provide a reliable, durable and cost-effective technology that can monitor the degradation of weapon systems at all length scales and in real-time for the entire operational life of the platform. It will enable cost effective, reliable, predictive en-route maintenance and lower the Navy's overall operating and maintenance costs.

HOW

Projected Business Model: Axalume will consider a variety of business opportunities including direct sales and/or working with a Navy-designated prime.

Company Objectives: To accelerate photonic sensing and interconnect adoption with differentiated lasers and optical sub-systems.

Potential Commercial Applications: Widely-tunable lasers for communications, structural health monitoring, and medical sensing applications.