

# Department of the Navy SBIR/STTR Transition Program

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NAVSEA #2021-0507

Topic # N18A-T011

Nondestructive Evaluator for Polymer Ablatives (NEPAL)  
Intelligent Automation, Inc.

## WHO

**SYSCOM:** NAVSEA

**Sponsoring Program:** IWS 3L (Missile Launcher Systems)

**Transition Target:** Vertical Launcher Systems: Structure and Canister

**TPOC:**  
(540)653-3639

**Other transition opportunities:** Post production quality check of ablatives inside VLS at Lockheed Martin

**Notes:** The goal for VLS is to determine the remaining number of launches. LCCP determines when the system has reached end of life. LCCP determines effective life left of plenum & uptake coatings using formulas based on # of shots, based on assumed erosion ratio. The remaining useful ablative thickness measurement is unlike any other type of thickness measurement using ultrasound NDE where the material properties usually remain constant across the thickness.



Photo courtesy of the US Navy

## WHAT

**Operational Need and Improvement:** Missile launch systems integrated with a ship structures, such as the Mk 41 vertical launch system (VLS), need the rocket exhaust to be diverted vertically upwards through the plenum and the uptake. These sections are lined with ablative polymers of varying thicknesses to protect the structure from intense heat from rocket exhaust. The remaining useful life of the ablative panels determines the life of the VLS. Currently, life prediction of these ablative materials is based on pre-determined in lab tests. However, as these multipurpose VLSs launch a variety of increasingly powerful rockets, the predetermined life estimations are inaccurate. A new non-destructive examination (NDE) technique is needed for in situ determination of the remaining useful life of ablative lining.

**Specifications Required:** The remaining useful life of an ablative depends on the remaining useful thickness of the virgin ablative under the pyrolyzed layers. To measure the virgin ablative thickness requires decoupling of material property variation with thickness from the remaining useful ablative tile thickness. Additionally, there is a requirement of dry contact with the ablative surface as additional moisture/liquid is detrimental to the ablative during missile launch. The goal of NEPAL is life extension based on updated real erosion data.

**Technology Developed:** IAI has developed NEPAL, a non-destructive evaluator for ablative materials to decouple material property variation with thickness from the remaining useful tile thickness. NEPAL uses unique sensing technique with completely custom and novel dry-coupled dual-mode ultrasonic transduction. We have designed and manufactured unique transducers, material model-based measurement algorithm and C-scan system to perform measurements over an area of ablative tiles. We have developed early prototype system to perform measurement in relevant environment.

**Warfighter Value:** NEPAL will measure the remaining useful ablative thickness in situ to maximize the life of VLS. The immediate role of the NEPAL tool will be to check the remaining useful ablative thickness at the end of life of each VLS in older ships. The extended role of the NEPAL tool is to update the Launch Control Computer Program (LCCP) calculations with actual ablative thickness measure in-situ at the port in newer ships. Navy will likely use NEPAL tool during a maintenance availability at a shipyard.

## WHEN

**Contract Number:** N68335-20-C-0155 **Ending on:** November 8, 2021

Milestone	Risk Level	Measure of Success	Ending TRL	Date
NEPAL transducer development	Low	Laboratory evaluation of dry coupled ultrasonic sensing	5	September 2021
NEPAL material model development	Low	Material testing, and simulation model	5	September 2021
NEPAL RUT algorithm	Low	Successful estimation of virgin ablative thickness	5	October 2021
Integrated NEPAL system	Low	Successful testing of integrated system at IAI laboratory	5	December 2021
Test and evaluation in relevant environment	Med	Evaluated performance at VLS production facility	6	March 2022

## HOW

**Projected Business Model:** IAI is developing production facilities to produce NEPAL systems and sell them directly to the Navy and through distribution via VLS manufacturers Lockheed Martin.

**Company Objectives:** IAI is developing customized manufacturing techniques to manufacture NEPAL sensors and semi-autonomous robot for larger scale production. IAI will manufacture NEPAL systems in 25,000 square foot manufacturing facilities. Once the manufacturing processes have been identified, IAI will begin to scale the size of the devices for additional military and commercial applications.

**Potential Commercial Applications:** Successful technology development will benefit military, commercial customers, and consumers by providing accurate estimation of remaining useful material thickness and remaining missile launches. Additional application of this technology is to estimate remaining metal thickness under coating and corrosion in ships and other structures.

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