

WHO

SYSCOM: ONR

Sponsoring Program: Office of Naval Research

Transition Target: SSN(X) - Next-Generation Attack Submarine

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Other Transition Opportunities: Navy surface ships.

Notes: Space comes at a premium onboard a submarine, and as the Navy moves towards faster, deeper, and more capable vessels at lower cost, that may force piping system design innovation. It will be necessary to employ more compact piping systems that can affect profile sensitive equipment like pumps and flow meters. The De-Correlator will reduce the straight pipe length requirement for this equipment to maintain operational efficiency and enable such compact system designs.

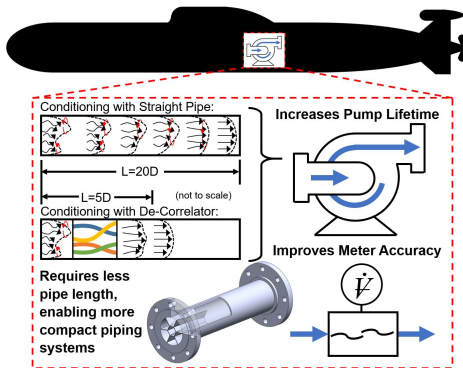


Image courtesy of Physical Sciences, Inc, 2022

WHAT

Operational Need and Improvement: Pumps and flow meters require a consistent, developed flow profile to function properly. Typically, this is achieved after flow disturbances through a minimum required length of straight pipe. This length requirement creates a packaging challenge as ship arrangement space is extremely valuable. An enabling technology is needed to reduce this length requirement to allow for more compacting piping designs without inducing a significant pressure drop.

Specifications Required: Straight pipe lengths to achieve uniform, swirl free flow profile shall be decreased by approximately 50% from the baseline non-conditioned flow profile. The device shall not induce significant drops in flow pressure or affect suction inlet positive pressure in pumps located higher in the ship.

Technology Developed: Physical Sciences Inc. (PSI) has developed the De-Correlator, a device that reduces inlet distortion by re-arranging a distorted flow into a fully developed pipe flow. The device works on a volumetric flow (stream tube) basis rather than introducing turbulent mixing, thereby allowing it to operate over a wide range of flow conditions to reduce distortions for minimal pressure drop. PSI has prototyped and tested the De-Correlator, finding it capable of removing more than 90% of incoming swirl and reducing the straight pipe length requirement from 20x to 5x pipe diameter.

Warfighter Value: The De-Correlator will improve the reliability and lifetime of flow sensitive equipment such as pumps and flow meters. This will help ensure the accuracy of flow monitoring systems, reduce maintenance requirements, and enable more compact piping systems. Less arrangement space required for piping opens up room for additional equipment to be deployed on the Navy vessel.

WHEN

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Round I Completion	Low	Preliminary proof of feasibility testing	3	2nd QTR FY20
Round II Completion	Medium	Design optimization, comprehensive performance testing, manufacturing and integration outlined	4	1st QTR FY21
Round III Completion	Medium	Design for manufacturing, CFD and FEA simulations, experimental demonstration of distortion removal in 5D	4	4th QTR FY21
Round IV Completion	Low	Identification of prime use case and technology transition strategy, prototype demonstrated in prime use case, preliminary qualification testing	5	4th QTR FY22

Contract Number: N00014-19-9-0010

Ending on: Sep 30, 2022

HOW

Projected Business Model: The commercialization strategy is to first address the needs for flow conditioners in the submarine community. PSI has engaged with General Dynamics Electric Boat, the primary designer and producer of submarines for the Navy, to better understand their flow conditioning needs and the pathway forward to technology implementation. Given the timescales needed to mature the De-Correlator design to achieve approval for use from the NAVSEA Technical Warrant Holders, the Next Generation Attack Submarine program, SSN(X), is the initial technology insertion program. Once the path to meet the needs of the submarine community is well established, PSI will expand the commercialization activities to include the needs of the Navy surface ships.

Company Objectives: The objective of the technology transition is for PSI to become a supplier of flow conditioners for primes such as General Dynamics Electric Boat. The De-Correlator would be a valuable asset in their toolbox that could be implemented to overcome spacing challenges as these primes go through the process of designing piping systems for next-generation Navy vessels. PSI plans to manufacture in-house at our facilities in Haverhill and Wilmington MA. These facilities have been specifically set up for aerospace and military-grade structures development and fabrication. In our 4,000 sq. ft. facility in Haverhill, PSI produces production runs of specialty equipment for Army and Marine special forces, Air Force airborne and spaceborne antennas, and hypersonic vehicle parts. Our 24,000 sq. ft. Wilmington facility is outfitted with additional capacity for larger/longer parts, greater production runs, and responsive product development.

Potential Commercial Applications: The oil and gas industry is likely one of the largest commercial markets for flow conditioning where the De-Correlator could provide significant benefits. Due to the sheer volume of fluid handled by typical oil and gas system, small errors in flow meter accuracy can propagate to significant, and costly, errors in total volume estimates. Removing distortion in the pipe flow is a critical step in ensuring these inaccuracies are minimized.

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