SON Number: MRSEED-23-S1 **28 October 2021**

Strategic Environmental Research and Development Program (SERDP)
SERDP Exploratory Development (SEED)

FY 2023 STATEMENT OF NEED

Munitions Response (MR) Program Area

DETECTION, LOCALIZATION, CLASSIFICATION, AND REMEDIATION OF MILITARY MUNITIONS UNDERWATER

1. Objective of Proposed Work

The objective of this SERDP Exploratory Development (SEED) Statement of Need (SON) is to develop technologies to detect, localize, classify, and remediate military munitions found at underwater sites. Capabilities are needed for a wide variety of aquatic environments such as ponds, lakes, rivers, estuaries, and coastal and open ocean areas. Munitions of interest range from small projectiles and mortars to large bombs, although proposals need not address the entire range of potential munitions with a single solution. Water depths up to 35 meters are of interest although there is a specific need for systems that can operate in depths less than 5 meters.

Proposals addressing any aspect of munitions response for underwater sites will be considered, with particular interest in the topics listed below. Listed beneath each topic are the specific needs for that area of interest.

Wide Area and Detailed Survey Technologies:

- Quickly characterize and map the environments that may contain munitions,
- Detect targets in a cluttered background,
- Classify targets under complex conditions,
- Identify specific types of targets; especially in a cluttered environment,
- Localize targets to allow rapid and accurate return for removal/disposal,
- Use stratigraphic techniques to describe the geophysical conditions of live sites, and
- Detect, localize, and classify buried or proud underwater UXO that is in close proximity to buried or proud clutter or other UXO.

Machine Learning:

- Couple machine learning with traditional computational modeling and human decision-making with emphasis on physics-based models and use of supervised, unsupervised, semi-supervised, and/or active learning techniques for decision support. Techniques suitable for the following use cases are encouraged: labeled training sets are small, and false negatives have higher consequences than false positives.

Munition Burial and Mobility:

- Address development of predictive models and understanding of the physical process that are responsible for burial, migration, and re-emergence of UXO in underwater

environments. Of special interest are UXO behaviors during extreme hydrodynamic events and for those munitions that are buried. Validation (demonstrations) of predictive models of UXO behavior is also encouraged.
- Site manager interests and concerns must be addressed.

Biofouling and Corrosion of Munitions:
- Studies of the long term impact on optical and acoustic sensing systems are requested. Also of interest is the effect on munition burial and mobility behavior. Experts in the fields of corrosion and biofouling are encouraged to team with sensor developers to include the science of those phenomena.

Optical Sensors:
- Investigation of the quality of the point cloud in terms of having sufficient resolution to discern proud, partially buried, and fouled UXO from the surrounding environment is encouraged. The degradation of the point cloud should also be quantifiable/predictable based on turbidity, depth, wave action and any other factors that could degrade resolution. Post processing and point cloud manipulation requirements should be considered.
- Development of a holistic understanding optical capabilities, which includes cost and useability.

Harbor Dynamics and Activity Impact on Munitions:
- Active harbors are a unique environment that present challenges to UXO remediation; studies are sought that address munition dynamic behavior, areal and depth distribution of munitions; and the impact of harbor activity, e.g., prop wash and dredging.

Platforms and Sensors:
- Platforms that operate in the dynamic nearshore environments and to depths exceeding 30 meters are required; sensors capable of detecting and classifying individual munitions noted in the objectives above are critical.

Cost-Effective Recovery and Disposal:
- Technologies are needed to cost-effectively and safely recover and remediate munitions in the underwater environment. Current practices employing divers for manual retrieval of targets are dangerous and, oftentimes, prohibitively expensive. Proposals should focus on recovery in the shallow water environment, where munitions are likely to be encountered by the public (up to depths routinely accessed by recreational divers) and should address explosive safety issues. Cost-effective, safe, and environmentally acceptable remediation techniques are also needed for underwater items that cannot be moved due to explosive safety concerns and where blow-in-place operations underwater can significantly impact marine life.

Proposals submitted under this SON should consider operation in a variety of conditions with regard to salinity, water depth, water turbidity, bottom characteristics, depth of burial, and clutter scenarios in a variety of marine, brackish, and freshwater environments. Proposals addressing contamination of soils and water by munitions constituents are not within the scope of this SON.

2. Expected Benefits of Proposed Work

Results from this work will provide expanded capability to cost-effectively characterize, remediate, and manage munitions response sites in the underwater environment and to deploy advanced technologies for a wide diversity of site conditions.

3. Background

As a result of past military training and weapons testing activities, munitions are present at sites designated for base realignment and closure (BRAC) and at Formerly Used Defense Sites (FUDS). Modern geophysical surveying techniques can effectively be used to characterize sites potentially contaminated with munitions on dry land. However, many sites contain munitions underwater, where the environment both restricts access to and may significantly impact the performance of established and emerging characterization technologies.

The U.S. Army Corps of Engineers (USACE) and the U.S. Navy have identified more than 400 underwater sites that are potentially contaminated with munitions. The majority of areas are in shallow water (0-120 feet) where the munitions pose a threat to human health and the environment. Property potentially containing munitions in underwater environments exceeds 10 million acres.

Complementary SERDP & ESTCP-Funded Projects: Currently, SERDP and ESTCP are supporting efforts to develop an understanding of the performance of acoustic and geophysical sensors for this mission. Other projects are addressing the issue of underwater munitions characteristics and their environment. Proposers are strongly encouraged to become aware of ongoing and recent research supported by SERDP and ESTCP and to clearly articulate how the proposed work is novel or different than existing work. More information regarding these efforts can be found at the SERDP and ESTCP website.

4. Cost and Duration of Proposed Work

To meet the objectives of this SEED SON, proposals should not exceed $250,000 in total cost and approximately one year in duration. Work performed under the SEED SON should investigate innovative approaches that entail high technical risk and/or have minimal supporting data. At the conclusion of the project, sufficient data and analysis should be available to provide risk reduction and/or a proof-of-concept. SEED projects are eligible for follow-on funding if they result in a successful initial project.

5. Point of Contact

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For SEED proposal submission due dates, instructions, and additional solicitation information, visit the SERDP website.