

Request for Technologies

Title: Evaluation of in-line instruments for measuring Total Residual Oxidant (TRO) of ship's ballast water

Date: **08-April-2019**

Program: Alliance for Coastal Technologies (ACT)

Application: Application form (with signed cover letter) must be received by 5:00 PM on **10-May-2019**

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The Alliance for Coastal Technologies (ACT) is currently accepting preliminary applications from developers and manufacturers of commercially-available Total Residual Oxidant (TRO) instruments (e.g., amperometric sensors and DPD kits) used to monitor TRO in shipboard ballast water treatment applications. In-line TRO instruments are often used as part of the control systems for ballast water management systems (BWMS) that employ oxidant-based treatments (e.g., sodium hypochlorite, chlorine dioxide, and ozone) and are used to monitor discharges. Therefore, accurate and reliable measures of ballast water TRO are crucial. ACT will be conducting independent verification testing under controlled laboratory conditions, using water prepared to represent both coastal water (including freshwater and brackish environments) and offshore marine water that targets the quantification of TRO instrument performance (e.g., accuracy, precision, detection limits, range, etc.). Like all ACT Technology Evaluations, participation in this effort will be free of charge for qualifying applicants, and results will be made available to the public in individual summary reports.

ACT is a component of U.S. Integrated Ocean Observing Systems (IOOS), funded by NOAA, EPA and MARAD, and a partnership of research institutions, agencies, state and regional resource managers, and private sector companies interested in developing, improving, and applying sensor technologies for studying and monitoring aquatic environments. ACT was established on the understanding that instrument validation is necessary so that effective, existing technologies are recognized and promising new technologies can be made available to support both successful coastal science and resource management, and the long-term success of IOOS. The specific functions of ACT are to serve as: (1) an unbiased, third-party testbed for evaluating existing, new, and developing coastal sensors and sensor platforms, (2) a comprehensive data and information clearinghouse on coastal technologies, and (3) a forum for capacity and consensus building.

Please visit our website at www.act-us.info for additional information on ACT, to download application forms, and for detailed information on the ACT performance evaluation (including deadlines). More information can also be obtained by contacting Dr. Mario Tamburri (tamburri@umces.edu).

Synopsis of Program

The Alliance for Coastal Technologies (ACT) provides an unbiased, third party testbed for evaluating existing, new and developing sensors, and related technologies, for studying and monitoring freshwater, coastal, and ocean environments. ACT seeks to review TRO instruments that may be used to monitor an oxidant-based BWMS that uses chlorine or other oxidants to kill aquatic organisms. The instruments may also be associated with the BWMS control system, providing feedback to regulate dosages or to initiate neutralization. Regardless of their location of use or their purpose, the TRO instruments should be capable of operation across a spectrum of water types including fresh, brackish, and marine waters. Within this range, the instruments will be challenged with water varying in temperature, pH and concentrations of dissolved organic matter. The instruments should be capable of operating within a span of conditions typical of commercial ship ballasting operations.

It is important to note that ACT does not certify technologies or guarantee that a technology will always, or under circumstances other than those used in testing, operate at the levels verified. ACT does not seek to determine regulatory compliance; does not rank technologies or compare their performance; does not label or list technologies as acceptable or unacceptable; and does not seek to determine “best available technology” in any form. ACT will avoid all potential pathways to picking “winners and losers”. Therefore, although performance verification will apply to all instruments evaluated under common testing protocols, no direct comparisons will be made between instruments from different manufacturers and instrument-specific Verification Statements will be released to the public for each instrument type as a final report.

Focus of Performance Verification

Accurate measurements of TRO are critical to verify the performance of oxidant-based BWMS and to assure water discharged into the environment does not exceed the regulatory or target concentrations. As BWMS incorporate in-line TRO instruments for monitoring and control, it is important to understand the performance of these critical technologies (relative to a standard measurements of TRO). It is also important to understand the limitations of TRO instruments, considering that the source water characteristics will vary.

This ACT Performance Verification will therefore focus on the suite of instruments capable of operation with various water types. The performance evaluation will quantify instrument accuracy, precision, dynamic range and limits of detection, as compared to manual measurements using the standard, DPD-based colorimetric approach for measuring TRO [Standard Method SM 4500-Cl G]. Protocols and a detailed test plan will be developed with the aid of applicants and a Technical Advisory Committee (TAC) to evaluate these specific parameters under controlled laboratory conditions. Source water for testing may include natural water, amended natural water, and artificial lake water or seawater. Water temperatures may vary within the spectrum of navigable, surface waters. Laboratory tests will at minimum use hypochlorite (either injected or as a product of saltwater electrolysis), but testing may include trials with other BWMS oxidants (e.g., chlorine dioxide, ozone). TRO instruments will be placed into a flow-through pipe loop. Test water will flow through the pipe loop, and the measurements from TRO instruments (whether inserted into the line or sampling from it) will be compared to manual TRO readings from water collected from an adjacent sample port. Instrument consistency through time may

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also be considered as part of this verification. However, issues surrounding shipboard integrations (e.g., maintenance, reliability, and robustness) are beyond this scope of this initial evaluation.

Eligible Technologies Must Be:

- Commercially available technologies.
- New, near-commercial technologies that are ready for the market with available quality testing data to support performance claims.
- Designed to directly measure biocidal oxidants.

Multiple (two or three) instruments may be requested from each participant, depending on the specific evaluation protocols developed and timing of test deployments. ACT will take responsibility for the instruments during the verification testing and will return all units when the evaluation is complete. Qualifying applicants will also be asked to participate in the design of evaluation protocols. The results and summaries from all verifications will be provided to qualifying applicants and made public after evaluations are complete. Because of limited resources, ACT may select to evaluate only one instrument model or type per individual developer, manufacturer, or distributor depending on the numbers of qualifying applicants. We will, however, consult with applicants if this selection process is necessary.

Benefits of Technology Evaluation

ACT will provide technology developers an independent, scientifically objective process for testing their instruments in a diverse range of coastal and freshwater environments and under actual situations for which their products were designed. Moreover, ACT results will provide potential investors and users of innovative approaches with information on how technologies perform in comparison to conventional methods. Through this process of verification, ACT will ultimately aid in the implementation of accurate and reliable technologies that will enable the effective monitoring and an increased understanding of coastal resources and processes. Specific benefits for technology developers, manufacturers, and vendors:

- Access to expertise in demonstrating, verifying, and applying coastal monitoring technologies.
- An opportunity to test a technology on a nation-wide basis under different environmental conditions.
- An unbiased, reputable evaluation of technology performance.
- Increased credibility from having independent performance data.
- Increased potential of regulatory acceptance due to the recognition of ACT results.
- increased recognition nationally and internationally through ACT outreach.
- A potential market advantage that customers and users may consider in their technology purchasing decisions.
- Increased confidence for investors.

Specific benefits for technology users:

- Timely information on the performance of instruments required to address an environmental emergency and recovery.
- Easily accessible information on coastal instrument technologies.

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- Credible technology performance verifications and demonstrations independent of developer, manufacturer, or vendor claims.
- Performance-based verification and demonstration testing addressing realistic data quality objectives under varying environmental conditions.
- ACT and MARAD support of verification and demonstration results.

Application and Acceptance

The application and acceptance process consists of four steps: a preliminary application, conditional acceptance, a full application, and agreement on a test plan. The tentative schedule and deadlines for each step are provided below.

Step 1: Preliminary Application. Applicants (developers, manufacturers, and distributors) are requested to provide summary information about the technology proposed for testing and about their organization by submitting a signed cover letter (no longer than two pages) and by completing the ACT Application for Evaluation form (to be posted at www.act-us.info/rft.php). The purpose of the preliminary application is to assess if the technology meets the criteria/requirements set forth in this Request for Technology (RFT), if ACT facilities are capable of conducting an appropriate and safe evaluation, and to ensure that no conflict of interest exists between the applicant and ACT. Preliminary applications are screened and categorized by ACT Headquarters staff based on at least the following criteria:

- Does the technology fit the stated theme?
- Does the technology address the stated priorities?
- Is the technology applicable to continuous, in-line analysis?
- Is the technology based on sound scientific and technical principles?
- Is the technology sufficiently commercially ready for verification testing?
- Can the applicant demonstrate ownership of the technology?

Step 2: Conditional Acceptance. All applicants that meet the requirements for an ACT Technology Evaluation will be identified and accepted contingent upon the successful completion of Steps 3 and 4. Acceptance notification will be delivered to the applicant within one week of the receipt of the initial application.

Step 3: Full Applications. The Full Application for testing requests additional information about the technology to ensure a clear understanding of the proposed technology, including the scientific and engineering principles of operation, previous performance data (if applicable), and potential users/customers. The application should include appropriate peer review literature, technical articles, reports, process flow diagrams, equipment specification sheets, operating instructions, and other related materials to enable the reviewer to fully understand the technology and any data and information that is available to support the application. Full applications must also include proposed protocols for conducting the evaluation. The draft protocols should be based on standard scientific testing practices and must include:

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- Requirements for qualifications of test personnel.
- Requirements for health and safety of test personnel, the public, and the environment.
- Proposed methods and procedures for verification including: a) set-up, b) period of operation, c) operation parameters, d) experimental design with number of replicates and controls, and e) demobilization.
- A standard measure or existing, accepted technology for the new technology to be calibrated by or tested against.
- Proposed methods and procedures for storing, retrieving, analyzing, and reporting data.

Step 4: Agreement on Test Plan. ACT Headquarters staff, Technology Advisory Committee, Technical Coordinators for each Partner Institution, QA/QC Coordinator, and representatives for each qualifying applicant will gather for a workshop to be scheduled in **June 2019** by teleconference to discuss and draft a Verification Plan based on the recommendations for each qualifying applicant and an appropriate QA/QC strategy. The draft will be externally reviewed for appropriateness of experimental design and statistical analyses before a Final Verification Plan is submitted to the qualifying applicants. Although ACT does not conduct direct comparisons of instruments being evaluated, the standardization of methods in Verification Plans will allow the assessment of the various instruments simultaneously and permits end-users to draw their own conclusions regarding the TRO instruments that best meets their needs.

Deadline and Dates

- Initial Application (form with signed cover letter) must be received by 5:00 p.m. Eastern Time – **10-May-2019**
- Notification of Conditional Acceptance **17-May-2019**
- Full Application packages due **31-May-2019**
- Protocol Workshop (Teleconference) **June-2019** (tentative)
- Final verification protocols and Test Plan **28-June-2019**
- Laboratory testing tentatively scheduled to begin in **05-August-2019**

Verification Agreement

A legal agreement between ACT and individual qualifying applicants will be drafted to state that all parties agree to conduct the evaluation in accordance with the final Verification Plan and that the results will be released to the public. The agreement will also state that there will be no modifications to final Verification Plan, regardless of unforeseen circumstance encountered during testing, without written consent from all parties. Furthermore, the agreement will clearly state that although the developers, manufacturers, or distributors will be allowed to view the Verification Statements before they are released to the public, they will not be allowed to make changes to the final report. Under special circumstances ACT will consider inclusion of comments (in the form of a one-page letter) from the developers, manufacturers, or distributors as an appendix to Verification Statements. Finally, it will be noted that all data collected during verifications by the instruments tested are the property of the

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proponent and cannot be used by any other party without consent. The agreement will be signed by the ACT Director and the appropriate representative from the qualifying applicant's organization.

Additional Information and Forms

Please visit our website at www.act-us.info for additional information on the ACT program, details on the ACT Evaluation Process, and to download required application forms. More information can also be obtained by contacting Dr. Mario Tamburri (tamburri@umces.edu).

Technical Advisory Committee

- Rich Everett; U.S. Coast Guard
- Ray Frederick; U.S. EPA
- James Jensen; SUNY-Buffalo
- Carolyn Junemann; Maritime Administration
- Gail Roderick; U.S. Coast Guard Research and Development Center