Great Lakes Ballast Water Research and Development Plan – Research Area 1, Project 4: *Evaluating the effectiveness of filtration technologies.*

The Lake Superior Research Institute's (LSRI) -Great Waters Research Collaborative (GWRC), in collaboration with the U.S. Department of Transportation Maritime Administration (MARAD), is issuing this request for application (RFA) to invite filter systems (FS) developers/manufacturers to participate in a filter testing opportunity at the GWRC Montreal Pier Testing Facility in Superior, Wisconsin.

Solicitation Opening Date: 16 Nov 2022
Solicitation Closing Date: 20 Jan 2023

I. BACKGROUND/INTRODUCTION

The Vessel Incidental Discharge Act of 2018 (VIDA) established the Great Lakes and Lake Champlain Invasive Species Program (GLLCISP), with the goal of decreasing the introduction and spread of aquatic nuisance species (ANS). Ballast water management systems (BWMS) could be used to address this issue; however, these low temperature, high turbidity, and low salinity waters pose extra challenges to BWMS, which were initially developed for use on oceangoing vessels. As a result, there has been very little testing and slow adoption of BWMS in the Great Lakes and Lake Champlain, although some BWMS employ technology that could perform effectively under these conditions. The Great Waters Research Collaborative (GWRC) is conducting the *Great Lakes Ship Ballast Water Research and Development Plan*, with support from the United States Environmental Protection Agency's (USEPA's) Great Lakes Restoration Initiative (GLRI) via the Maritime Administration (MARAD).

This is the second call for applications to invite FS developers/manufactures to participate in a filter testing opportunity. The first call issued in July was able to support three interested FS. We are looking for 1-2 more FS developers/manufactures to participate in the program.

II. AWARD INFORMATION AND ELIGIBILITY FOR PARTICIPATION

Estimated Number of Participants: 1-2
Funding Amount: The tests and data will be provided free of charge[1] to participating FS developers

To qualify, FS (as manifolded subunits or a single unit) must be:

- Representative of models provided to ships (i.e., capable of continuous ballasting without creating damaging pressure swings or deadheading the ballast pump); and
- Capable of a 200 – 340 cubic meters (m^3) per hour flow rate (test rate to be determined based on preferences of the participants).

[1] except shipping, installation and removal costs.

III. PROJECT GOALS

Determine if current filtration technologies are suitable for ballast water management in the Great Lakes.

This research project is designed to fill data gaps associated with filter performance under Great Lakes conditions of water quality and biology by measuring the performance of ballast water filters when challenged with freezing cold waters, ice, filamentous protists, and high concentrations of total suspended solids. The *ETV Protocol* (2010) specifies an acceptable water temperature range for BWMS testing from 4 - 35°C. Great Lakes water temperatures can be consistently < 4°C for several months of the shipping season, and during the winter months the presence of pack ice and freezing water could cause operability issues for BWMS. BWMS filters are typically tested with solids that have diameters in the micron range, which is substantially smaller than the floating lake ice that could be taken up during ballasting. Ice is unique in its ability to potentially recombine after passing through the sea chest grating. Great Lakes protist populations may also cause filter performance issues. Specifically, filamentous diatoms and cyanobacteria, some of which have filaments well over 100 µm in length, taken up in ballast can rapidly clog filter systems necessitating near-constant filter backflushing and decreased ballast flow rates and cargo off-loading operations. Commercial ports with high concentrations of suspended solids may create a similar operational challenge.

A. Scope of Work, Project Timeline, and Deliverables

Each filter will be subjected to three rounds of testing as outlined in Table 1.

Table 1. General experimental approach to filter testing.

Round	Type	Brief Description	Time Frame	Flow Rate Target
1	Warm Water Testing	Testing in water > 4°C with a combination of augmented and non-augmented water	Spring 2023	Near nominal for filter
2	Cold Water Ice Particle Testing	Testing in water < 4°C with crushed ice particles	Winter 2023	Lower than nominal
3	Warm Water Testing	Testing in water > 4°C with a combination of augmented and non-augmented water	Spring 2024	Near nominal for filter

Comparison of results from the warm water tests (rounds 1 and 3) will demonstrate filter performance under challenging water conditions, with any substantial decrease in performance highlighting damage that may have occurred during the ice test. Additionally, damage to the filter may also be assessed individually, in a manner dependent on each filter's unique design.

1. Warm Water Testing

The warm water tests (rounds 1 and 3) will consist of two identical days, during which the filter will operate first with ambient harbor water for 60 minutes, and then be challenged with augmented water containing inorganic and organic material multiple times until the system reaches a near failure state*, at which point augmentation will be suspended so the filter can recover. The filter will then operate with ambient harbor water to identify any performance changes resulting from the challenge. During warm water testing, flow rates near each filter's nominal rate will be targeted (up to the facility maximum of 340 m^3/hr) and filter performance will be assessed (Table 2).

* The near failure state will be defined as a flow through rate that is 25% of the nominal flow capacity for the filter, unless the filter vendor and GWRC develop and agree upon a different definition prior to testing.

Table 2 Variables measured during warm water tests.

Parameter	Description	Units
Organism Removal	Percent reduction from intake of IMO/USCG plankton size classes: ≥ 50 microns and ≥ 10 and < 50 microns	%
Organisms in Discharge	Absolute numbers and mortality assessment of organisms in the IMO/USCG plankton size classes in discharge: ≥ 50 microns and ≥ 10 and < 50 microns	#/m^3 and cells/mL, respectively
Pre-Filter Flow Rate	Measure of flow rate upstream of the filter	m^3/hr
Post-Filter Flow Rate	Measure of flow rate downstream of the filter	m^3/hr
Backflush Flow Rate	Water lost to backflushing (Pre-Filter Flow Rate minus Post-Filter Flow Rate)	m^3/hr
% Volume Backflushing	% of the total volume filtered that was backflushed	%
% Time	% of duration that backflushing occurs	%

Parameter	Description	Units
Backflushing		
Pre-Treatment Pressure	Pressure near the filter inlet	bar
Post-Treatment Pressure	Pressure near the filter outlet	bar
Differential Pressure	Pressure loss over the filter (inlet pressure minus outlet pressure)	bar
Backflush cycle times	Durations of backflush and time between backflushes	minutes

2. Cold Water Ice Testing

The potentially damaging effects of ice and cold water on filter performance will be evaluated in this round, conducted while the water surrounding the Montreal Pier Facility is ice-covered. Ballast water filters will be operated in an indoor heated space (>7°C) during this evaluation. A simulated ice pack that passes a 15 mm sieve will be created in the water adjacent to the pier, and a portable pump designed to pump water containing hard and soft solids will be used to deliver ice-laden water to the filter. Fewer operational parameters (pre and post filter pressure, post filter flow rate, backflush flow rate) are measured for the ice test compared to warm water testing because performance measurement in this round is pass / fail:

- If the filter can't pass the ice laden water or if there is apparent damage to the filter, the filter does not pass and will not continue to round 3.
- If the filter can pass the ice laden water without issue the system has passed round 2 and will continue to round 3 (warm water testing) to search for performance decline that may have occurred when filtering out ice particles.

3. Deliverables

The data from this project will be published and will be publicly-available. This project will produce data on the operational and biological efficacy of FS used. Drafting of the publication will be a collaborative process, and applicants will be asked to provide feedback on potential (Great Lakes-specific) technology improvements, lessons learned, cost/benefit of technology, etc., for inclusion in the publication.

4. Project Milestones and Timeline

Table 3 below describes the projects major milestones and a tentative timeline.

Table 3. Major Project Milestones and Anticipated Timeline for Great Lakes Ballast Water Research and Development Plan – Research Area 1, Project 4: Evaluating the Effectiveness of filtration technologies.

Project Milestone	Projected Timing
Notification of Acceptance into Project	February 2023
FS delivery and installation	March-April 2023
Development of Test/Quality Assurance Plan	February-April 2023
Trial #1 - warm water	Spring 2023
Trial #2 - cold water	Winter 2023-2024
Trial #3 - warm water	Spring 2024

IV. CONFIDENTIALITY

The FS team is responsible for providing any confidentiality or non-disclosure agreement desired **prior to planning the test design**. LSRI-GWRC will maintain confidentiality of any declared proprietary information relative to the technology subject to testing and will work with the manufacturer to ensure that proprietary technologies are referred to in a generic and categorical way in all planning and reporting documents.

This effort is supported with U.S. federal funds, and the data generated will be made available to the public. GWRC, in collaboration with the proposal team, will also publish findings in peer-reviewed scientific or technical journals, or other publications as deemed appropriate. GWRC will not publish declared proprietary information in publicly available documents.

We encourage technology manufacturers to exclude proprietary information from application materials. If inclusion of such information is necessary, a confidentiality or non-disclosure agreement must be provided to LSRI-GWRC and completed prior to the submission of application materials.

V. APPLICATION PREPARATION AND SUBMISSION

Submit a letter of intent to Jen Maki (jmaki@uwsuper.edu) by 16 December 2022 that briefly describes the FS and how it aligns with the goals of R&D Plan – Research Area 1, Project 4. Within five working days of receipt, an upload link to the LSRI Egnyte Ballast Water Server will be sent to the applicant for proposal submission.

Applications will be accepted until 5:00 pm CST on 20 January 2023 via the provided Egnyte upload link. Proposals are limited to 15 pages, not including the cover page, and must include the following information:

I. **Cover Page**
PDF-fillable form provided by LSRI-GWRC that includes applicant contact information and other information required for administration of funds.

II. **Proposal Team, Scope of Partnership, and Roles in the Project**
Brief introduction of each member of the proposal team, explanation of their role in the project, and any experience with shipboard and/or port-based evaluation of BWMS (research and development testing or regulatory testing).

III. **Filter System Description**
The filter system provided must be fully functional with all the valves, filter elements, pressure sensors and automation necessary for operation. Model and operational characteristics, description of any previous testing (either research and development or regulatory) performed in freshwater (not limited to the Great Lakes System). Provide the filter installation and /or operation manual with your application. At a minimum list the following characteristics of the filter model to be tested in your application:

a. Inlet / outlet / backflush pipe size and piping standard
b. Air connection size if any
c. Electrical connection requirements
d. Filter flow range and expected backflush flow rates
e. Rough dimensions
f. Weight

IV. **Budget**
Provide an itemized budget for cost of the filter system and any required component(s).

V. **Referenced Documents**
List the documents cited in the proposal.

VI. PROGRAMMATIC AND FUNDING CONTACTS

For any questions relating to the technical or programmatic aspects of this request, please contact Jen Maki, GWRC Project Lead, at jmaki@uwsuper.edu or +1(715)394-8422.

For any questions relating to the engineering or facility aspects of this request, please contact Tyler Schwerdt, GWRC Engineering Lead, at tyler.schwerdt@amiengineers.com.

For any questions about the administration of this funding opportunity, please contact Matthew TenEyck, LSRI Director, at mteneyck@uwsuper.edu or +1(715)394-8160.

VII. REFERENCED LITERATURE

Frank Lobiondo Coast Guard Authorization Act of 2018, Pub. L. No. 115–282, 176 (2018).

U.S. Environmental Protection Agency. (2010). *Generic Protocol for the Verification of Ballast Water Treatment Technology,* EPA/600/R-10/146. Environmental Technology Verification Program.