

U.S. Department of
Homeland Security

United States
Coast Guard



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Subj: CLARIFICATION ON AUGMENTATION OF CHALLENGE WATER
PARAMETERS (WATER QUALITY AND ORGANISMS) FOR BALLAST WATER
MANAGEMENT SYSTEM (BWMS) TESTING

Ref: (a) Title 46 Code of Federal Regulations (CFR) Part 162.060
(b) EPA/600/R-10/146, Generic Protocol for the Verification of Ballast Water
Treatment Technologies, version 5.1, dated September 2010

Dear 

The Coast Guard has received requests from Independent Laboratories (ILs) for clarification of requirements regarding augmentation of challenge water during testing of ballast water management systems for type approval.

Reference (a), referred to hereafter as regulations, requires land-based testing to be performed in accordance with reference (b). Testing protocols in reference (b), hereafter referred to as the protocol, allow test facilities to augment challenge water to achieve required test conditions as long as such augmentations are validated to result in conditions representative of the natural environment. This letter clarifies the Coast Guard's expectations regarding augmentation of challenge water.

As per the requirements in the protocol, the Coast Guard will not approve BWMS tested using augmented challenge water that does not include validation of augmentation procedures. The guidance provided here should be taken into consideration by ILs and brought to the attention of accepted sub-laboratories and test facilities.

The following information is taken from the text of the protocol (*emphasis added*) to highlight the intent with regard to water quality and organism challenge conditions.

Section 3.1 of the protocol states that:

“Systems that will be tested under this program will be capable of treating the entire discharge or ballast water volume for biological organisms, either through a one-step treatment process or through multi-step treatment processes, and will be capable of treating a wide range of source water typical of ballast uplifted from fresh, coastal, estuarine and/or marine origins.”

Section 5.2 stipulates the following objectives of the protocol:

- “To verify a treatment system’s performance using a set of challenging but not rare water quality conditions *representative of the natural environment.*”, and
- “To verify removal or kill of bacteria, protists, and zooplankton *using ambient organisms* as defined by size classes and analytical techniques that identify living quantities for these organisms.”

Section 5.2.1 states:

“Since water quality conditions in ports and harbors around the world vary greatly, treatment systems may encounter a wide range of conditions. Also, *certain water quality conditions may interfere with the ability of some treatment processes. It is therefore critical to evaluate the effectiveness of a treatment system under water quality conditions that are challenging to the technology being tested.*”

Section 5.2.1 allows for water quality and organism augmentation during land-based testing when ambient challenge water conditions do not meet the required levels:

“Challenge waters have been tailored to a minimum set of water quality conditions that may be achieved either through naturally occurring conditions or through augmentation, if appropriate, and validated by the TF [test facility]”.

Required challenge conditions are specified in section 5.2.1, Table 3, for water quality parameters of salinity, dissolved organic carbon (DOC), particulate organic carbon (POC), mineral matter (MM), and total suspended solids (TSS). *Section 5.2.1.1 stipulates that natural water is to be used in meeting the salinity conditions.*

Under section 5.2.2, “Biological efficacy will be evaluated as a function of a system’s ability to kill or remove *organisms that are naturally occurring and represent the more robust ambient populations at the test site*”.

Required challenge conditions are specified in section 5.2.2.2, Table 4, for organism concentration and diversity for the three size classes listed in the regulations. Where the addition of organisms for the augmentation of ambient organisms is required, the method for the injection or addition of organisms must be validated by the test facility. Section 5.3.3 contains specific provisions for validation that the mechanical means of augmentation (for both water quality and organisms) do not result in mortality to ambient and augmented organisms that would confound interpretation of the effectiveness of the BWMS.

The Coast Guard interprets these above statements to indicate that, in general, test conditions are to be representative of natural conditions that will be encountered by ships using installed BWMS. Natural water quality conditions can affect the performance of treatment systems. The range of conditions specified for each water quality or biological parameter reflects an attempt to be challenging, but still practicable. If augmentation is necessary to achieve the

required conditions, the substances used to augment water quality conditions must result in conditions representative of the natural conditions, and challenge water that is augmented must not be less challenging to the BWMS than would be the case if the naturally occurring substances were present in sufficient quantity to meet the challenge requirements. Species used to augment organism concentrations to meet the challenge water requirements must be naturally occurring at the test site. Further, it is not acceptable to select specific organisms for use in augmenting organism concentrations that are more easily treatable by ballast water management systems. As with water quality conditions, augmented organism assemblages must not be less challenging to the BWMS than would be naturally occurring assemblages with sufficient concentration to meet the requirements. Selecting non-ambient cultured organisms for use in augmenting organism concentrations on the basis of ease of culturing or augmentation, with no assessment to ensure the cultured organisms were not more susceptible to treatment than ambient organisms would not be acceptable.

Validations of augmentation approaches should be conducted under the supervision of Coast Guard accepted ILs to ensure that augmentation does not lessen the challenge conditions compared to circumstances where augmentation was not employed and the required challenge conditions were due solely to the natural conditions of the ambient water. More detailed guidance for water quality and organism augmentation is provided below.

Water Quality Augmentation. Natural waters are to be used for fresh, brackish and marine salinity conditions. If augmentation is necessary to achieve the required salinity conditions, the water used for the augmentation must be obtained from a natural source. Water quality conditions of natural waters are known to affect a range of water treatment processes including disinfection by-product formation, chemical reaction rates, and absorption of ultraviolet energy.

Neither the protocol nor the Coast Guard prescribes what specific additives are considered acceptable for BWMS testing. The basis for the selection of the augmentation additives must be fully explained and validated to ensure that the selected additives provide an appropriate challenge representative of the natural environment for BWMS treatment processes. The test facility must validate that augmented water does not present less of a challenge to a BWMS than would occur if the water quality requirements were met in the natural water without augmentation. The test facility must also validate that the injection or addition procedures and mechanisms minimize organism mortality and result in a well-mixed distribution of the augmentation substances in the challenge water.

Organism Augmentation. If concentrations of relevant organisms in the ambient assemblage are insufficient, the test facility may choose to augment organisms to achieve necessary concentrations. Organisms naturally occurring at the test site should be used. Organisms for use in augmentation might be obtained through several means, including: harvesting/concentrating in bulk from the ambient source water, non-selective culturing of bulk ambient source water through addition of nutrients (to increase concentrations of species broadly, not to create "blooms" of a single or a few species), or use of selected cultured ambient and/or non-ambient organisms. In cases where ambient organisms are concentrated through harvesting or culturing, all efforts should be made to preserve natural relative frequency distributions in the resulting challenge water (i.e., abundant taxa in the ambient water must also be relatively abundant in augmented water). In cases where non-ambient test organisms are used, the test facility must

evaluate and document that the non-ambient organisms added to the challenge water represent an equivalent challenge to the BWMS compared to ambient organisms. The test facility must also validate that the injection or addition procedures and mechanisms minimize organism mortality and result in a well-mixed distribution in the challenge water.

Enclosure 1 contains a suggested organizational outline for documentation of the selection and validation of augmentation substances and procedures.

While the Coast Guard does not require augmentation approaches and methods to be approved in advance, if an IL wishes to discuss potential augmentation and validation approaches, inquiries should be directed to: Chief, Environmental Standards Division (CG-OES-3) at environmental_standards@uscg.mil. Such inquiries should be done with substantial lead time, due to the technically complicated issues involved, to avoid last-minute delays. Further, the Coast Guard advises that, although not required, ILs should, as part of their quality management programs, consider arranging for independent 3rd party peer review of proposed augmentation and validation approaches. In cases where the Coast Guard requires outside expert technical perspective during review of type approval applications, independent 3rd party reviews conducted prior to submission of type approval test reports that include augmentation may reduce the time necessary for Coast Guard review.

This guidance is not a substitute for applicable legal requirements, nor is it itself a rule. It is not intended to, nor does it impose, legally-binding requirements on any party. It represents the Coast Guard's current view on this topic and may assist industry, mariners, the general public, and the Coast Guard, as well as other federal and state regulators, in applying existing statutory and regulatory requirements.

If you have questions regarding the above, please contact CDR Meridena Kauffman of my staff at meridena.d.kauffman@uscg.mil.

Sincerely,



S. J. Kelly
Captain, U.S. Coast Guard
Chief, Office of Operating and Environmental
Standards

Copy: Control Union Certifications BV
Korean Register of Shipping (KR)
Lloyds Register EMEA
NSF International
USCG COMDT (CG-ENG)
USCG Marine Safety Center (MSC)

Enclosure 1

Outline

Recommended Organization for Documentation and Validation of
Augmentation of Water Quality Conditions or Organism Concentrations

- 1) Explanation of need for augmentation.
 - a) What parameters are proposed to be augmented?
 - i) E.g., DOC, or organisms greater than 50 μm , etc.
 - b) Why is augmentation necessary, and under what circumstances?
- 2) Explanation of relevance to BWMS performance.
 - a) Water quality parameter:
 - i) What is the naturally occurring make-up of the WQ parameter at the test site?
 - ii) What are the potential effects of the naturally occurring parameter on the BWMS treatment processes?
 - (1) Explain how this parameter affects the treatment processes that are involved in the BWMS - e.g., absorption of UV light in the biocidal wavelengths; shadowing; clogging of filters; background oxidant demand; rate of oxidation reactions; production of disinfection byproducts; etc.
 - b) Organisms:
 - i) What are the characteristics of the naturally occurring assemblage, in terms of abundance, diversity, size distribution, and resistance to the treatment processes?
- 3) Explanation of the appropriateness of the proposed augmentation.
 - a) WQ parameters:
 - i) Specific augmentation substance;
 - (1) Quantitative explanation of why use of this specific substance will not result in a less challenging test than if the WQ parameter requirement were achieved entirely under the ambient conditions. Consider all aspects of the effects of the parameter on the treatment processes involved. Provide data from comparative experiments testing for significant differences in critical aspects such as % absorbance of UV in the biocidal range, reaction rates of treatment chemicals, production of disinfection by-products, etc.
 - (2) Quantitative explanation of why the method of augmentation (i.e., injection, mixing, etc.) will not result in adverse impacts on organisms that confound the ability to evaluate the effectiveness of the BWMS.
 - (3) Quantitative explanation of why the method of augmentation (i.e., injection, mixing, etc.) will result in a well mixed distribution of the augmented substance in the challenge water.
 - b) Organisms;
 - i) Specific size class or taxa to be augmented
 - (1) Explanation of why this augmentation is consistent with using naturally occurring organisms in the ambient assemblage.
 - (2) If not part of the local assemblage, why has the non-local organism or group of organisms been selected?

- (3) Quantitative explanation of why the organism or group of organisms selected does not result in a less challenging test of the efficacy of the BWMS compared to the ambient assemblage when present at required concentrations.
- (4) Quantitative explanation of why the method of augmentation (i.e., injection, mixing, etc.) will not result in adverse impacts on organisms (those added and those in the ambient water) that confound the ability to evaluate the effectiveness of the BWMS.
- (5) Quantitative explanation of why the method of augmentation (i.e., injection, mixing, etc.) will result in a well mixed distribution of the augmented organisms in the challenge water.