

Why MPN?

There is no scientific dispute that destroying an organism's ability to reproduce is an effective means of preventing and controlling aquatic invasive species. Here are six reasons why the USCG needs to accept the [MPN method](#) as an equivalent alternative to the vital stain method (promoted by the USCG) for determining the number of living organisms in the 10 – 50 µm size class.

6 Reasons the USCG Needs to Accept the MPN Method

1. Ballast water management systems that render organisms non-reproductive and harmless **meet the spirit and letter** of the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA), National Invasive Species Act (NISA), and USCG Final Rule.
2. Low-energy UV-based ballast water management systems are **safe, well-established for protecting human health and the environment, more “green”** than other systems.
3. UV-based ballast water management systems are **the most effective for use in fresh water**, as they are not adversely impacted by salinity.
4. MPN is an appropriate test method for all ballast water management systems, and is **widely-recognized as accurate, practical, and protective**. The vital stain method is not practicable or applicable for UV.
5. Accepting the MPN method will **harmonize U.S. and international ballast water regulations**, and benefit the shipping industry.
6. Accepting the MPN method is **consistent with the USCG's public representations, and will promote innovation and competition**.

1. MEETS THE LAW

Meeting the Spirit and Letter of the Applicable Law

- The term “living” is not defined in the U.S. ballast water regulations. However, it is defined in relevant government documents regarding ballast water:

A viable or living organism is defined as “an organism that has the ability to pass genetic material on to the next generation.” [Efficacy of Ballast Water Treatment Systems: a Report by the EPA Science Advisory Board, July 12, 2011, p.75](#)

Moreover, it is scientifically and universally accepted that the definition of “living” or “life” in the context of all biological organismal systems requires the ability to reproduce (*Mader, 1994*).

- The USCG is responsible for issuing guidelines “to prevent the introduction and spread of nonindigenous species ...”; the guidelines “shall ... direct a vessel ... to use environmentally sound alternative ballast water management methods ... if the Secretary determines that such alternative methods are at least as effective as ballast water exchange in preventing and controlling infestations of aquatic nuisance species;” [16 U.S.C. 4711\(c\)](#); *DHS Delegation No. 0170.1(II.)*(57).
- The USCG Final Rule defines a ballast water management system as any system which processes ballast water to kill, render harmless, or remove organisms. It has two discharge standards for the 10 – 50 µm size class – they are as follows:
 - Great Lakes and Hudson River ([Subpart C, §151.1511](#)): *For organisms less than 50 micrometers and greater than or equal to 10 micrometers: discharge must include fewer than **10 living organisms** per milliliter (mL) of ballast water.*
 - Waters of the United States ([Subpart D, §151.2030](#)): *For organisms less than 50 micrometers and greater than or equal to 10 micrometers: Discharge must include fewer than **10 organisms** per milliliter (mL) of ballast water.*

Taken literally, the standard for U.S. waters other than the Great Lakes and Hudson River (i.e., ocean waters) requires a ballast water management system to remove (not “kill or “render harmless”) all but <10 organisms per milliliter (mL). The Final Rule defines a ballast water management system as “any system which processes ballast water to kill, render harmless, or remove organisms.”

This definition of ballast water management system, set forth at [33 CFR §151.1504](#) and [46 CFR §162.060-3](#), expressly admits systems that render organisms harmless. With its preliminary decision to reject the MPN method, the USCG is ignoring its own definition of a ballast water management system on the grounds that “The regulations specifically require ballast water management systems to be evaluated based on their ability to kill certain organisms.” That is, a ballast water management system that “renders harmless” the treated organisms meets the Final Rule’s definition of a ballast water management system, but doesn’t pass the USCG’s artificially high interpretation of the discharge standard.

Mader, S (1994). Inquiry into Life; 7th edition, Brown (William C.) Co., U.S.

2. UV IS PROVEN

Low-energy UV-Based Systems are Safe, Established, and Green

UV systems use light in the germicidal range, meaning that it neutralizes organisms by rendering them incapable of reproduction. This capability has allowed widespread adoption of UV light as an environmentally friendly, chemical-free, and effective way to disinfect and treat water. Today, UV-based water treatment systems protect over **one billion people** from harmful effects of invasive organisms in drinking water and wastewater applications.

UV-based ballast water management systems do not use or generate substances that will be “persistent, bioaccumulative, or toxic when discharged” ([46 CFR 162.060-10\(f\)\(5\)](#)), and they do not produce explosive gases.

In contrast, chlorine-based ballast water management systems increase environmental risk due to potential for chlorine discharge and the formation of [disinfection by-products, which](#)

[is of increasing global environmental concern](#) (*more citations [here](#)*). These systems also produce H₂ gas, which increases risks of explosion.

The USCG has the ability, today, to Type Approve ballast water management systems which were submitted in March 2015. In fact, in August 2015 Admiral Paul Zukunft, Commandant of the USCG, indicated that USCG Type Approval of the three UV-based systems that were submitted in March 2015 was imminent:

“We’re working with four independent labs right now to validate (technology) submittals. There are three submittals right now in the final stage. Eight others are in the initial stage of review. I’m pretty optimistic we will have Coast Guard approved ballast water standards by the IMO conference in November.”

- [Maritime Reporter and Engineering News, August 2015, p.35](#) (quoting Admiral Paul Zukunft)

UV technology utilizing the MPN method is ubiquitously used to protect global human health, supported by the [world’s foremost scientific experts](#), and just as protective of the environment, if not even more so, than the currently approved measurement method.

Delacroix, S., Vogelsang, C., Tobiesen, A., Liltved H. (2013). Disinfection by-products and ecotoxicity of ballast water after oxidative treatment—results and experiences from seven years of full-scale testing of ballast water management systems.

Gonsior, M. et al (2015). Bromination of Marine Dissolved Organic Matter Following Full Scale Electrochemical Ballast Water Disinfection. Environmental Science & Technology, DOI : 10.1021/acs.est.5b01474.

Helmholtz Zentrum Muenchen – German Research Centre for Environmental Health (2015).

Shah, A.D., Liu, Z., Salhi, E., Höfer, T., Werschkun, B., von Gunten, U. (2015). Formation of disinfection by-products during ballast water treatment with ozone, chlorine, and peracetic acid: influence of water quality parameters.

Werschkun, B., Sommer, Y., Banerji, S (2012). Disinfection byproducts in ballast water treatment: An evaluation of regulatory data. Water Research. 46: 4884-4901. Doi:10.1016/j.watres.2012 .05.034.

3. UV IS FLEXIBLE

Eliminating Low-energy UV-based Systems will Leave Shipowners with few, if any, Cost-Effective Options for Treating Fresh Water

UV treatment is not adversely impacted by salinity, making it an ideal choice for fresh water. Of the 56 [AMS letters of approval](#), there are only five systems approved for use in fresh water, four of which are UV-based.

However, the USCG's preliminary decision to reject the MPN method essentially makes chemical-based systems the only viable option for shipowners trading in U.S. waters, and particularly the Great Lakes – the largest group of fresh water lakes on earth. Most chlorination systems generate chlorine using salt water – the use of these systems in fresh water requires installation of brine tanks, which increases costs and reduces cargo capacity.

4. MPN IS PROVEN

MPN is an Appropriate Test Method for UV-Based Ballast Water Management Systems

MPN is a well-established quantitative method to estimate the number of viable cells in a sample. It is a culture-based method that assesses the ability of an organism to colonize after treatment. It is useful for any treatment technology, not just UV, since neither dead nor non-reproductive organisms can reproduce. ([40 CFR 141.74](#))

The USCG Final Rule itself uses grow-out testing to measure organisms in the <10 µm size class, i.e., all of the bacteria (E. coli, Enterococci, Vibrio cholerae, HPCs) in the discharge standard. [ETV Protocol, 5.4.6.7 Organisms 10 µm](#)

However, the USCG does not currently consider the MPN method to be an equivalent alternative to the [vital stain](#) method for the 10 – 50 µm size class. The USCG opines that the vital stain method is “applicable and practicable” for UV-based ballast water management systems.

The USCG's current position disregards scientific data showing that unduly substantial power increases (~10x) are needed for UV-based ballast water management systems to disrupt invasive organisms' enzymatic activity to the point of measurement with the ETV Protocol (vital stain method). *MacIntyre et al. (2015), Estimating phytoplankton viability using a culture-based most probable number assay, vital stains, and variable fluorescence following UV-C treatment. J. Phycol.*

Also, [according to a USCG-approved Independent Laboratory](#), dramatic increases in UV dose require substantial increases in power in combination with reductions in flow and/or operational restrictions on the water quality for which the system is approved.

5. US & IMO HARMONIZED

Accepting the MPN Method will Harmonize U.S. and Global Ballast Water Regulation, and Benefit the Shipping Industry

The USCG recognizes the [importance of the IMO](#), thus its Final Rule permits an [Alternate Management System](#) (AMS) approved by foreign governments under the standards set forth in the IMO BWM Convention. [33 CFR §151.2026](#)

The USCG has accepted dozens of systems and hundreds of models (as AMS) for use in U.S. waters, including the ones subject to the preliminary decision to reject the MPN method.

Thousands of vessels already employ UV-based ballast water management systems that have been certified by the IMO and issued Type Approval. For many years the IMO has recognized MPN as an appropriate method to determine treatment system efficacy. If the USCG's preliminary position on the MPN method is maintained, low-energy UV-based systems capable of treating poor quality water at ports throughout the world will be deemed unsuitable, and shipowners may have to bear the substantial financial and operational burden of uninstalling their existing system.

Consistent enforcement between U.S. and IMO would avoid harm to shipowners and the parts of the U.S. economy that depend on shipping in U.S. waters.

6. PROMOTES COMPETITION

Accepting MPN is Consistent with the USCG's Public Representations, and will Promote Innovation and Competition

The USCG publicly committed to consider alternative test methods to determine “viability” of organisms treated by UV-based ballast water management systems. In a USCG presentation given in July 2015, it was noted that “Systems tested using ‘viability’ analyses rather than live/dead methods may or may not meet Coast Guard requirements. Coast Guard is working with UV manufacturers, the EPA-ETV Program, and other stakeholders to evaluate potential methods for assessing the effectiveness of UV in rendering organisms in ballast water non-viable.”

In effort to introduce innovative and “green” technology with desirable characteristics for the shipping industry, UV-based ballast water management system suppliers have collectively invested more than one hundred million dollars. In addition to rendering these efforts futile, if the USCG does not accept an applicable and practicable alternative test to evaluate UV-based ballast water management systems, competition will be stymied by the elimination of roughly half of the system suppliers.

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