Fact Sheet

Performance Verification of Ship Ballast Water Treatment Technologies and Exchange Screening Technologies

January 2007 (Revised June 2011)

The EPA's Environmental Technology Verification Program (ETV) with cooperation from the U.S. Coast Guard's National Ballast Water Management Program has developed performance verification protocols for new ballast water treatment technology designed for installation onboard commercial ships. Additionally, ETV cooperated with the Coast Guard to develop a protocol to evaluate technologies that screen whether ballast water exchange has taken place. Ballast water exchange is a procedure involving open ocean back-flushing of ballast tanks with sea water while in transit. This is the current approach used by ships to reduce the introduction of marine organisms at the point of ballast water discharge. However, this procedure is viewed by experts as an interim solution since ballast exchange is not equally effective for all ship types. Also, the procedure cannot be performed during rough sea conditions because of safety and structural concerns.

Background: The overwhelming majority of the world's trade goods are transported by modern ships which use water in ballast tanks to maintain trim and stability during transit and while performing dockside cargo loading and unloading operations. An unintended consequence of this vital mode of commerce is the uptake and transport of marine organisms in ships' ballast water, and the deposition of these organisms during ballast water discharge into non-native, and ecologically sensitive coastal areas. Although many organisms don't survive the journey, some species flourish in their new environments lacking natural predators. The more environmentally tolerant species can become invasive and alter the ecological balance by outcompeting indigenous populations for food and habitat. Invasive species can cause significant damage to water treatment infrastructure as evidenced by the Zebra and Quagga mussel infestations of the Great Lakes. In addition to the variety of marine organisms found in ballast tanks, ballast water samples taken from a ship entering the Port of Houston were found to contain cholera, thereby raising public health concerns about the possible spread of disease through ballast water discharge.

Recent advances in establishing both national and international ballast water discharge standards to reduce the global proliferation of aquatic invasive species has encouraged private industry to develop treatment technologies and exchange screening technologies to address the proposed standards**.** Recognizing the need for these technologies to be independently evaluated and verified, and to accelerate commercialization and marketplace acceptance, the EPA with cooperation by the U.S. Coast Guard has developed a protocol for the land-based performance verification of shipboard ballast water treatment technologies and for ballast water exchange screening technologies. Further development of a shipboard testing protocol will begin in late summer, 2011.

Project Descriptions

Ballast water treatment technology: The Generic Ballast Water Treatment Technology Verification Protocol (http://www.epa.gov/nrmrl/pubs/600r10146/600r10146.pdf) completed in September, 2010 is designed for use at land-based testing facilities to evaluate the biological effectiveness of treatment technology prior to installation onboard ships. The protocol will accommodate full-scale marine or fresh water systems for either in-tank, flow-though, or combination treatment approaches. Water quality conditions are adjusted to represent extreme, but not rare, natural conditions. In addition to using ambient organism populations during testing, standard test organisms representing bacteria, zooplankton, protists, and phytoplankton species are recommended. The protocol was pilot-tested at the Naval Research Laboratory's (NRL) Ballast Water Treatment Technology Testing Facility at Key West, Florida. The protocol is currently being used in an evaluation of the reproducibility of testing results for ballast water treatment technology tested at different commercial facilities. Data obtained from this study will be used to improve and revise the protocol as necessary. The ETV Program is also developing a shipboard technology verification protocol that will address ship-specific verification factors and provide biological sampling procedures for ship-installed ballast water treatment technologies. Use of these treatment systems on board commercial vessels will ultimately contribute to reducing the risk of proliferation of aquatic invasive species worldwide.

Ballast water exchange screening technology: The US Coast Guard's Research and Development Center at New London, Connecticut, collaborated with EPA's ETV Program to develop a protocol for evaluating the performance of ballast water exchange screening technologies. Desirable attributes of the screening technologies are that they be robust, rapid, accurate and portable. The protocol was completed in January 2007 and was used to evaluate the Ballast Water Exchange Assurance Meter (BEAM) manufactured by Dakota Technologies, Inc. One parameter which distinguishes open ocean water from coastal water is colored dissolved organic matter (CDOM). CDOM refers to the fraction of dissolved organic matter that absorbs light and fluoresces in the ultra-violet and visible regions of the spectrum. The BEAM ballast water exchange screening tool is a portable technology which measures CDOM. The BEAM was evaluated against a standard, lab-based CDOM measurement approach which uses excitation-emission spectrometry under controlled laboratory conditions. The technology was evaluated for accuracy, linearity, precision, method detection limit, inter-unit reproducibility, temperature effects, matrix effects, data completeness, and operational factors such as ease of use and maintenance. The final Verification Report for the Dakota Technologies BEAM is available on the ETV Program's web site (http://www.epa.gov/nrmrl/std/etv/pubs/600etv07057.pdf).

Technical Contacts: Treatment technologies - Ray Frederick at 732-321-6627 or frederick.ray@epa.gov and Tom Stevens at 734-769-5347 or stevenst@nsf.org; Exchange screening technologies – Amy Dindal at 561-422-0113 or dindala@battelle.org.