

**U.S. Environmental Protection Agency
Science Advisory Board
Ecological Processes and Effects Committee Augmented for Ballast Water Advisory
July 29 - 30, 2010**

Summary Minutes

Date and Time: July 29 (9:00 am – 5:00 p.m.) and July 30 (8:30 a.m. – 2:30 p.m.), 2010

Location: St. Regis Hotel, 923 16th Street, N.W., Washington, D.C.

Purpose: The purpose of the meeting was to provide advice to EPA on technologies and systems to minimize the impacts of invasive species in vessel ballast water discharge.

Attendance:

Members of the EPA Science Advisory Board (SAB) Ecological Processes and Effects Committee Augmented for the Ballast Water Advisory:

Dr. Judith Meyer (Chair)
Dr. E. Fred Benfield
Dr. Ingrid Burke
Dr. JoAnn Burkholder
Dr. G. Allen Burton
Dr. Peter Chapman
Dr. William Clements
Dr. Andrew Cohen
Dr. Loveday Conquest
Dr. Robert Diaz
Dr. Fred Dobbs
Dr. Lisa Drake
Dr Charles Haas
Dr. Thomas W. La Point
Dr. Wayne Landis
Mr. Edward Lemieux
Dr. David Lodge
Mr. Kevin Reynolds
Dr. Amanda Rodewald
Dr. James Sanders
Dr. Mario Tamburri
Dr. Nicholas Welschmeyer

SAB Staff:

Thomas Armitage, Designated Federal Officer
Iris Goodman, Designated Federal Officer
Anthony Maciorowski, Deputy Director, SAB Staff Office
Vanessa Vu, Director, SAB Staff Office

EPA and U.S. Coast Guard Representatives:

Ryan Albert, EPA Office of Water
Richard Everett, U.S. Coast Guard
Robin Danesi, EPA Office of Water
Deborah Nagel, EPA Office of Water

Public (who were present or requested the call-in number for the meeting):

David Adams, New York State Office of Invasive Species Coordination
Bruce Bowie, Canadian Shipowners Association
Allegra Cangelosi, Great Ships Initiative, Northeast-Midwest Institute
Jon Steward, International Maritime Technology Consultants
Susan Sylvester, Wisconsin Department of Natural Resources
Raymond Vaughan, New York State Attorney General's Office

Meeting Summary:

Thursday, July 29, 2010

Convene the meeting

Dr. Thomas Armitage, Designated Federal Officer (DFO) for the SAB Ecological Processes and Effects Committee, convened the meeting at 9:00 a.m. Eastern Daylight Time. He stated that the Committee was meeting to provide advice to EPA on ballast water treatment systems to control the spread of living organisms that might be discharged from vessel ballast water tanks (see Federal Register Notice announcing the meeting¹). He stated that the EPA Science Advisory Board (SAB) was a chartered federal advisory committee and he reviewed Federal Advisory Committee Act (FACA) requirements. He stated that summary minutes of the meeting would be prepared and certified by the Chair. He noted the Panel's compliance with ethics requirements. He indicated written public comments² had been submitted for the Committee's consideration and that they were posted on the SAB website. He also noted that several requests had been received from the public (see list of public speakers³) to provide oral comments and that the meeting agenda⁴ included time to hear those comments. Dr. Armitage introduced Ms. Iris Goodman of the SAB Staff Office and indicated that she would also be serving as a Designated Federal Officer for the Committee. Dr. Anthony Maciorowski, Deputy Director of the SAB Staff Office then provided welcoming

remarks. Following Dr. Maciorowski's remarks, the meeting was turned over to Dr. Judy Meyer, Committee Chair.

Review of Agenda and Purpose of the Meeting

Dr. Meyer asked the members of the Committee to introduce themselves and reviewed the meeting objectives and agenda. She stated that the Committee would be providing advice to EPA on the efficacy of ballast water treatment systems and technologies. She noted that this SAB advisory activity was different from many other SAB activities because the Committee had not been asked to review a specific product but to synthesize literature provided by EPA and develop advice in response to a number of specific charge questions⁵. Dr. Meyer noted that EPA had provided a large number of background documents⁶ to the Committee. These included an EPA issue paper titled *Availability and Efficacy of Ballast Water Treatment Technology*, and numerous reports containing information on the potential efficacy of various ballast water treatment systems. Dr. Meyer noted that in the issue paper, EPA had indicated that ballast water discharges were a major source of nonindigenous species introductions to marine, estuarine, and freshwater ecosystems in the U.S., and therefore a stronger ballast water management program was being developed. Dr. Meyer also noted that the agency was asking the SAB for an evaluation of the efficacy of ballast water treatment systems that were in existence or in the development process.

Dr. Meyer indicated that, given the task of synthesizing the large amount of information provided by EPA and the complexity of the issues, additional Committee meetings would be held to deliberate on the responses to the charge questions and develop the Committee's report. She noted that at this first meeting, the Committee would hear public comments and background presentations from EPA and the U.S. Coast Guard, have an opportunity to ask questions to EPA and the U.S. Coast Guard, discuss the Committee members' preliminary comments in response to the charge questions, and develop a plan for completing the work.

Dr. Meyer reviewed the charge questions that had been provided to the Committee. She noted that the four charge questions and their subparts focused on: 1) the performance of shipboard systems with available testing data, and the potential performance of systems without reliable testing data; 2) changes or additions that could be made to improve the performance of ballast water treatment systems, and technological constraints and other impediments to developing ballast water treatment technologies; and 3) limitations of available data and future assessment needs. Dr. Meyer indicated that the Committee should address the charge questions but was free to provide comments on other issues and concerns.

Dr. Meyer then reviewed the meeting agenda. She noted that the Committee would first hear presentations from EPA and the U.S. Coast Guard on activities to regulate ballast water discharge. The Committee would then hear public comments, discuss initial comments from members in response to the charge questions, and develop a plan for completing the work. She indicated that the discussion of the plan for completing the

work should address: the scope of the Committee report, additional information needs, future meetings, how work should be partitioned, specific assignments, and next steps.

EPA and U.S. Coast Guard Presentations

Several EPA speakers and one speaker from the U.S. Coast Guard made presentations to the Committee. Their presentation slides⁷ were included in the meeting materials on the SAB Web site (see materials cited).

Evaluating the Efficacy and Availability of Ballast Water Treatment Technology

Ms. Deborah Nagle, Associate Director of the Water Permits Division in EPA's Office of Water provided introductory remarks to the Committee. She thanked Committee members for providing advice to the agency. She provided an overview of Clean Water Act authority to regulate ballast water discharge and described EPA's work to develop a vessel general permit for ballast water discharge. She discussed effluent limits and factors that were considered in defining best available technology and developing water quality based effluent limits. She indicated that EPA was seeking advice from the SAB to develop numeric technology-based effluent limits for the next vessel general permit, and she described EPA's schedule for developing the permit. She also described a parallel study underway at the National Academy of Sciences to examine approaches for establishing ecologically protective ballast water discharge limits.

Committee members asked clarifying questions. Members asked questions about differences between the charge to the National Academy of Sciences and the charge to the SAB. They asked questions about how EPA defined best available technology and questions about the technologies that should be considered by the Committee. EPA and Coast Guard staff responded to questions from the Committee. They described how best available technology was defined in the context of permitting. The Deputy Director of the SAB Office reminded Committee members that, as an independent body, the Committee was free to address issues beyond the specific charge questions that had been provided.

U.S. Coast Guard Ballast Water Discharge Standard

Dr. Richard Everett of the U.S. Coast Guard presented an overview of the U.S. Coast Guard's proposed ballast water discharge standard. He discussed the ecological impacts of nonindigenous species introduced into U.S. aquatic ecosystems in vessel ballast water. He described how ballast water was used to maintain the stability of ships, and provided an overview of the design of vessel ballast water tanks. He then discussed the authority for the Coast Guard's proposed rulemaking to promulgate a ballast water discharge standard, the timeline for implementing the discharge standard, the organisms found in ballast water, and the elements of the proposed discharge standard. The Chair then called for a short break. Following the break, Dr. Everett discussed available ballast water treatment technologies and tests that were used to determine the efficacy of treatment systems.

Capabilities of Shipboard Ballast Water Treatment Technology

Dr. Ryan Albert of EPA's Water Permits Division presented additional information on the regulation of ballast water discharges in the U.S. His presentation covered EPA's vessel general permit, U.S. Coast Guard regulations implemented under the authority of the National Invasive Species Act, the characteristics of vessels that are regulated, and existing vessel general permit ballast water limits.

Dr. Albert next presented additional information on technologies (mechanical, chemical, and other energetic) that were used to treat vessel ballast water. He also discussed living organism standards that had been suggested or used by the international community or domestic regulatory agencies. In addition, he reviewed the four charge questions (and their subparts) that had been given to the Committee. In his presentation, Dr. Albert indicated that ballast water management systems used to meet International Maritime Organization (IMO) discharge standards (Regulation D-2) were required (by convention) to be approved by the governments under whose flags vessels operated. He noted that this process, known as "type approval," was described in the IMO Guidelines for Approval of Ballast Water Management Systems. Dr. Albert described the treatment efficacy test protocols set forth in those guidelines. He noted that a number of treatment system efficacy reports had been provided to the Committee. He described this material and discussed some of the limitations of the test data. These limitations included the use of non-standard methods, lack of test facility validation documentation, sampling concerns, and sample analysis concerns.

Members asked EPA and Coast Guard staff clarifying questions. A member noted that no information had been presented about how to ensure the competency of personnel to operate ballast water treatment systems. EPA and Coast Guard staff responded that ballast water treatment systems would have to be designed to be operated by able bodied seamen. Ship owners would have to make sure that systems were operated properly in order to achieve established standards. A member commented that the treatment technology type approval information provided to the Committee appeared to indicate that some of the systems had a high rate of failure in meeting standards. EPA and Coast Guard staff responded that the Committee had been given information about many treatment systems. Not all of the systems had been approved and there were many questions about interpretation of the test data.

A member asked EPA and Coast Guard staff whether the European Union had developed regulations or guidelines for ballast water treatment systems. EPA and Coast Guard staff briefly described international efforts to harmonize testing procedures for ballast water treatment systems.

The Chair then thanked EPA and Coast Guard staff for their presentation. She indicated that the Committee would break for lunch and then hear public comments. She noted that following public comments, there would be additional time for Committee members to ask questions to EPA and Coast Guard staff.

Public Comments

Dr. Meyer stated that four individuals had registered to provide public comments. She asked the speakers to present comments in the order in which requests to speak had been received by the SAB Staff Office.

Bruce Bowie of the Canadian Shipowners Association commented on the use of vessel ballast water treatment systems in the Great lakes. He noted that many of the systems designed for ocean voyages would not be effective in Great Lakes waters and that no available systems could meet the needs of the Great Lakes Fleet. He identified the following concerns: many systems that required chemical reactions would not work in very cold water, many systems that required time for biocides or chemical processes to kill target organisms would not be effective on short trips, many systems that required filtration could not accommodate the flow rates typical of Great lakes operations, and existing vessels did not have space to accommodate many treatment systems. He commented that an analysis of the efficacy of treatment systems should include an analysis of whether it would be technically feasible to install them on Great Lakes vessels and whether they would work in the Great Lakes environment.

Jon Stewart of International Maritime Consultants commented on the development of technologies for vessel ballast water treatment. He noted that in developing these technologies it was important to understand their capabilities, whether they could meet water treatment goals, the costs of the technologies, and the barriers to their application. He identified the drivers of technology development. These included market conditions and regulatory approval requirements. He commented that the market for ballast water treatment technologies initially focused on technologies that could be broadly accepted, and that expansion of the market into niche areas would eventually address the need for effective treatment in particular bioregions such as the Great Lakes. Mr. Stewart identified a number of challenges to the development of ballast water treatment technologies. These included: lack of understanding of EPA and Coast Guard requirements, differences in global versus regional market demand, lack of supporting science, approval uncertainty, and the consideration of business risks versus rewards. He commented that technology could be developed to meet higher discharge standards but this would require technology and market maturation and supporting science.

Susan Sylvester of the State of Wisconsin Department of Natural Resources commented on challenges faced by the State in developing ballast water discharge standards. She indicated that Wisconsin had voiced a desire to have a strong national discharge standard for ballast water in order to prevent introduction of new invasive species into the Great Lakes. She noted that invasive species had taken a toll on the Great Lakes. She noted that the State of Wisconsin had issued a state ballast water discharge permit with a standard that would be 100 times more stringent than the International Maritime Organization standard. The permit also required a determination of whether treatment technologies were commercially available to meet the discharge standard. She noted that there was a critical need for information on the availability and efficacy of treatment

technologies in order to make policy decisions on risks posed by organisms introduced from vessel discharges. She noted that advice from the SAB would be very valuable to the State's decision-making process.

Allegra Cangelosi of the Northeast-Midwest Institute commented on the need for additional information on the effectiveness of ballast water treatment technologies. She noted that land-based evaluation of treatment technologies was important. She commented on the need for additional knowledge of biological assemblages in fresh and cold water. She commented that it should not be assumed that shipboard testing of technologies would be sufficient. She also offered a number of specific comments on filtering technology.

Dr. Meyer thanked the speakers for their comments.

Clarifying Questions to EPA and Coast Guard Staff

Dr. Meyer then called for additional clarifying questions from the Committee to EPA and Coast Guard staff. Members asked a number of clarifying questions.

A member commented that the charge questions focused on shipboard treatment systems. He questioned why onshore treatment systems were not being considered. EPA and Coast Guard staff responded that most of the research had focused on shipboard systems and that the Coast Guard did not regulate onshore facilities. EPA staff indicated that the agency did regulate onshore facilities but it appeared that onshore treatment would not be available in the near term.

A member noted that it was important to consider the cost of treatment. EPA and Coast guard staff responded that many factors had to be considered when evaluating technologies, including cost and energy use. They agreed that costs could not be ignored but suggested that the Committee's report not focus on costs.

A member commented that the availability of treatment systems would depend upon the standards to be met. EPA and Coast Guard staff responded that systems had been tested to the IMO standard, but more stringent standards had been proposed and it was desirable to develop and test more effective systems.

EPA and Coast Guard staff responded to questions from members about whether the vessel general permit was applicable to different kinds of vessels (including cruise ships). A member commented that ballast water treatment technology flow capacity appeared to be a very important issue. He also remarked that the State of Wisconsin planned to use ballast water exchange as well as other treatment options. EPA and Coast Guard staff agreed that flow capacity was an important issue.

Committee members asked whether EPA or the Coast Guard had certified ballast water treatment technology testing centers. EPA and Coast guard staff responded that facilities had not received certificates but after audits they were recognized as capable of

conducting procedures. A member also commented that an important issue was how to determine whether organisms in ballast water were alive after treatment. He questioned whether the Committee should consider this issue. EPA and Coast Guard staff responded that this was an important issue but it was difficult to address. A member commented that many invasive species (e.g., fish pathogens and protozoa) had life stages that made them difficult to sample. EPA and Coast Guard staff agreed that this also was a difficult issue to address.

A member commented that it was important to consider the efficacy of systems in marine versus fresh water systems. EPA and Coast Guard staff responded that, as noted in public comments, some vessels operated only in freshwater systems (e.g., the Great Lakes) and that some treatment systems were designed to use marine water to generate an oxidant.

Members discussed the issue of the quality of available testing data. Several members raised data quality issues and concerns. A member commented that, for type approval, there was no requirement to report failure rate. Another member commented that land-based testing data were not available for some systems, and that data did not appear to be available to evaluate the routine operation of systems on ships.

Following a break the Chair indicated that the Committee would begin its discussion of the members' preliminary comments in response to the charge questions. She indicated that the Committee would discuss the performance of shipboard systems, the development of treatment systems, and the limitations of available data and future assessment needs.

Discussion of Preliminary Comments in Response to the Charge Questions

Performance of Shipboard Systems

Dr. Meyer indicated that three Committee members (Drs. Drake, Tamburri, Welschmeyer) had been asked to lead the discussion of the performance of shipboard systems. She asked them to begin the discussion.

Dr. Welschmeyer indicated that the lead discussants had reviewed the treatment system information provided by EPA. He indicated that the lead discussants' initial comments focused on the systems listed in Group 2 (those with direct data reports) of Appendix IV in EPA's paper (*Availability and Efficacy of Ballast Water Treatment Technology: Background and Issue Paper*). He noted that the Committee members assigned to this topic had each agreed to lead the discussion of different treatment systems. Dr. Welschmeyer led discussion of the Ecochlor, Electro-Cleen, Gloen-Patrol, and PureBallast treatment systems. The following points were discussed.

- The Ecochlor system used chlorine dioxide as a potent biocide. A set of data generated by the University of Rhode Island showed that the biocide worked well. In tests in the Netherlands, some of the zooplankton needed to be filtered. The system had failed the German type approval test.

- Electro-Cleen was developed in South Korea. The active ingredient (oxidant) was formed by charging seawater, so the system would fail in freshwater. The oxidant was neutralized before discharge and the system did not include a filter. Members commented that no testing data were provided for the system but some data must have been available because the system had received type approval.
- Gloen-patrol was also developed in South Korea. The system used filtration and ultraviolet light treatment. No data were provided but the system also had received type approval.
- PureBallast was an ultraviolet sterilization system with mechanical filtration and a titanium oxide coating allowing sterilization by OH radicals. Limited information about the system was provided but it had received Norwegian type approval.

The Committee discussed the flow rates used in testing and a member asked the Chair whether developing a matrix to compare methods in freshwater and saltwater was within the charge to the Committee. The Chair responded that it was important to think about this and she indicated that the Committee might want to develop more than one matrix comparing the methods.

Dr. Drake led the discussion of the Greenship, Hyde Guardian, OptiMarin, and Peraclean systems. The following points were discussed.

- The Greenship system used an electrolytic cell to generate sodium hypochlorite. A land-based test of the system had been performed but it was not possible to draw conclusions based on the methods used and data provided. The sample volumes used in testing were not described.
- The Hyde Guardian system used filtration and ultraviolet light treatment. It had been type approved by the UK. It also had undergone shipboard technology evaluation program (STEP) testing. The technology appeared to be promising but it was not possible to say that it would meet the standards listed in Table 1 of EPA's white paper. A Committee member commented that data had been provided on the treatment of E. coli and enterococci but not cholera.
- The OptiMarin system used filtration and ultraviolet light treatment. No test data had been provided but the system had been type approved by Norway.
- The Peraclean (Sedna) system was a two-step process that used a hydrocyclone to separate solids. The water was then treated the water with a biocide (Peraclean). The system had been type approved in Germany but more testing was needed in cold water. Testing had been conducted in the Netherlands as well as onboard ship. Members commented that ballast water discharged from the system probably did not grossly exceed standards but this could not be determined from the available information. A member commented that cold water testing was

important. He noted that ballast water treatment system tests were usually conducted in spring and summer so cold water testing was often overlooked. Another member commented that insufficient data had been provided on this system.

Dr. Tamburri led the discussion of the NEI, OceanSaver, Siemens SiCure, and Severn Trent De Nora systems. He noted that test data had been provided for three of these systems. The following points were discussed.

- The NEI system used venturi oxygen stripping. Inert gas was introduced into ballast water to strip out oxygen. Large organisms were killed by cavitation. Whole effluent toxicity tests showed no effect. The method had undergone land-based toxicity testing at the University of Maryland as well as shipboard testing and had been type approved by Liberia, the Marshall Islands, and Malta. It was noted that this technology had been installed on commercial vessels. A member expressed concern about the sample volumes that had been used in testing but commented that a large amount of data had been provided. Members noted that these data could be further analyzed by the Committee.
- Members commented that the OceanSaver was the most complex ballast water treatment system considered by the Committee. Ballast water was filtered on uptake, treated by cavitation and electrochlorination, and filtered again before discharge. A member commented that the system might not work well in low salinity water but no data were provided. A member noted that the system was in use on some ships. A member commented that systems with filters sometimes required back flushing. Several members asked questions about the cavitation process and the lead discussants responded to those questions.
- Members commented that the Siemens SiCure was a chlorination and filtration system. The regulated chlorine dose was not neutralized before discharge. The system worked well in land-based testing and had been tested in cold water. A neutralization step was being added. Members commented that the system would be marketed for use onboard vessels in freshwater and saltwater. A member asked a question about the amount of space needed for the system. The lead discussant indicated that this and other information had been provided in reports (Lloyds and ABS) in the meeting materials.
- The Severn Trent De Nora system used filtration at uptake and discharge and electrolysis-electrochlorination with neutralization upon discharge. Members commented that Whole effluent testing (WET) had indicated some toxicity. It was noted that in some cases algae did not grow in the WET tests. Land based testing had been conducted and it appeared to indicate that the technology might meet the IMO regulation D-2 standard. Members commented that the technology was being used on at least one ship in the Shipboard Technology Evaluation Program.

The Chair thanked the lead discussants and other Committee members for their initial comments on the ballast water treatment technologies. A member suggested that it might be useful for the Committee to continue its deliberation by considering responses to charge question 4 (limitations in data and how to overcome those limitations) and then developing a flow chart to identify the need for further testing of the treatment technologies. The Chair responded that additional Committee meetings would be needed to deliberate on responses to the charge questions. She indicated that before the end of the day, she wanted to have a discussion of how to proceed. However, before holding that discussion she wanted to hear the Committee's initial comments concerning technological constraints and impediments to developing ballast water treatment systems.

Ballast Water Treatment System Development

Dr. Meyer indicated that four Committee members (Dr. Dobbs, Mr. Reynolds, Dr. Haas, and Mr. Lemieux) had been assigned to lead the discussion of technological constraints and impediments to developing ballast water treatment systems. She asked them to begin the discussion.

Committee members discussed the attributes and limitations of the treatment technologies listed in Table 5 of EPA's issue paper. Filtration technology was discussed. Members commented that filtration could be an effective treatment but it would not eliminate bacteria. It was noted that clogging was a problem in 40-45 micron filters. A member commented that filters as small as 25 microns were used but they reduced the flow capacity. Another member commented that back flushing was useful to address the clogging problem. The committee discussed ultraviolet sterilization and it was noted that this technology could be quite effective if the ballast water were clear.

Committee members discussed whether the treatment technologies could be expected to achieve zero or near zero discharge for certain organism size classes or types. Members commented that it might be possible to obtain near zero discharge for large organisms but this would be problematic for smaller ones. Members commented that if zero discharge were not achieved, treatments could selectively release certain less sensitive organisms. A member commented on the importance of treatment to eliminate dinoflagellates. A member commented that he thought none of the available treatment technologies would be likely to achieve the most stringent standards being considered. Another member commented that by using wastewater treatment technology, the most stringent standards for bacteria could be achieved. This, however, would be costly. He indicated that organisms in the 10 micron size range could be removed by ordering wastewater treatment of ballast water.

The Committee discussed the effectiveness of treatment technologies to eliminate viruses. The committee discussed importance of considering virus infectivity when deciding which ballast water treatment technologies to use. A member commented that ultraviolet, chlorine, and ozone treatment could be effective against bacteria and viruses depending upon contact time.

The Committee discussed possible changes or additions to treatment processes to improve the performance of ballast water treatment technology. The improvements discussed included: adding additional filtration and ultraviolet treatment, the use of feedback control sensors to indicate how well systems were working, using higher doses of biocides over a longer period of time (it was noted that neutralization of discharge would allow higher doses to be used), and using combinations of treatment methods.

The Committee also discussed indirect ways to improve the performance of treatment processes. A member commented that clarification of the discharge standards would exclude some technologies from further consideration (i.e., technologies that could not meet a standard would not be developed). The member also commented that clarification of test protocols would lead to better evaluations of test methods and improvements in technology.

The Committee discussed the need to optimize the process of ballast water treatment. Members commented that food safety had been addressed through the use of the hazard analysis and critical control points (HACCP) process. Members noted that HACCP was a management system to analyze and control biological, chemical, and physical hazards in raw material production, procurement and handling, manufacturing, distribution and consumption of the finished product. Members commented that such a system could be used to optimize ballast water treatment process.

Formation of Committee Subgroups to Address the Charge Questions

The Chair then thanked the members their initial comments on ballast water treatment system development and indicated that she wanted to discuss the Committee's process for developing responses to the charge questions. After discussing this issue, the Committee decided to form three subgroups to address the charge questions. The first subgroup would address charge questions 1 and 2, the second subgroup would address charge question 3, and the third subgroup would address charge question 4. Members were assigned to each of the subgroups and subgroup chairs were identified. It was agreed that, following the Committee meeting, each of the subgroups would develop draft charge question responses. These responses would be discussed at the next meeting of the Committee. The Chair then indicated that the Committee would recess and reconvene at 8:30 a.m. the following day.

Friday, July 30, 2010

The meeting was reconvened at 8:30 a.m. The Chair called for discussion of the limitations of available ballast water treatment technology data and future assessment needs. She indicated that the lead discussants for the topic were Drs. Cohen, Lodge, and Burkholder, and asked them to begin the discussion.

Limitations of Available Data and Future Assessment Needs

The Committee discussed the need for standardized protocols to test the efficacy of ballast water treatment technology. Members commented that test protocols should be standardized and applied across the full gradient of environmental conditions (e.g., temperature, salinity, biomass, global taxonomic diversity, dissolved organic carbon, and ship voyage duration). Members commented that tests should be conducted using appropriate sample volumes and that appropriate statistical methods should be used for analysis of the test data. Members commented compliance and enforcement needs should also be considered when developing test protocols. Members noted that it was probably not practical to use the full evaluation protocols in tests used for routine inspection. Members also commented that it was important to develop methods for assessing whether implementation of ballast water treatment actually prevented the distribution of invasive species. It was suggested that test metrics to be used for such assessments might include DNA, chlorophyll, and ATP.

The Committee also discussed other management practices that could reduce invasive species in ballast water. These included: consideration of when and where to take up ballast water, surveillance, risk assessments to target compliance and enforcement, and onshore treatment. A member commented that studies on the feasibility of onshore treatment had indicated that this was a viable treatment option.

A member agreed that it would be useful to test treatment systems across a range of diverse conditions, but he commented that there were no test facilities in remote areas like the arctic. He also noted that in developing test protocols it was important to define an adequate dataset. The Chair indicated that the Committee could provide recommendations to define an adequate dataset.

Following a break, the Committee further discussed issues to be considered when developing a standard testing protocol.

- It was suggested that, if systems could not be tested against a full range of conditions, some consideration might be given to local approval of the treatment system.
- It was suggested that identification of surrogate test species could be considered.
- It was suggested that alternatives to the use of living organisms (e.g., ATP) could be considered to test treatment systems.
- Members commented on the importance of using statistically appropriate sample volumes. Members commented that extremely large sample volumes were needed to verify a standard 1000 times more stringent than the IMO standard. Several members commented that it might not be possible to verify whether technologies could achieve standards more stringent than the IMO standard.

The Committee discussed onshore ballast water treatment technology. A member commented that the Committee had spent little time discussing onshore treatment. He commented that development of land-based ballast water treatment technology was not profitable for private industry but was probably the most effective and least expensive

approach. He noted that, if technology development were left solely to the market, land-based treatment systems would not be developed. The chair indicated that the Committee subgroups would consider how the SAB report should address land-based treatment

A member commented on the relevancy of the Coast Guard's ballast water rulemaking to the Committee's charge and deliberations. He commented that the Committee should evaluate available information that could indicate whether shipboard systems could meet the IMO standard or more stringent standards. Members discussed the challenge of conducting tests to verify that systems could meet standards at least ten times more stringent than the IMO standard. Members reiterated the comment that ballast water treatment technology tests might not have the resolution to verify that technologies could achieve levels lower than the IMO standard. A member identified two problems to be addressed in this regard: 1) he reiterated the problem posed by need for very large sample volumes, and 2) he indicated that methods for enumerating live organisms were crude. A member commented that the regulations had been written to require numeric standards for live organisms. EPA staff commented that the Committee might consider looking at short-term testing versus longer-term ballast water technology testing challenges and needs.

Members discussed the challenge of achieving standards for bacteria and viruses. A member commented that the IMO did not have standards for viruses. He noted that going beyond the IMO standard could require looking at bacterial sources in many parts of a ship. He questioned whether the Committee should consider this issue. Another member suggested that other sources of bacteria could be briefly addressed in the Committee's report, but this appeared to be somewhat removed from the charge. The Chair thanked members for their comments and indicated that following a break the Committee would further discuss the process for developing its advisory report.

Process for Developing the Committee's Report

The Committee discussed the process for reviewing the available information and developing the advisory report. The Chair asked members to identify any additional information that might be needed to address the charge questions. Members discussed obtaining additional information from the State of California. Several members identified additional reports and studies⁸ that could be useful to the Committee. The Chair asked members to send this material to the DFO.

The Committee discussed the problem of lack of available data to evaluate the treatment technologies. The Committee discussed the testing criteria that should be used to evaluate the technologies. A member suggested that the Committee develop its own criteria. Members commented that, in evaluating the available testing data, the Committee should consider issues such as quality assurance/quality control and whether a statistically appropriate study design and analysis had been used. A member commented that the Committee should determine whether the technologies had been tested in accordance with the IMO test protocol. He commented that it would also be useful to look at failure rate data.

The Chair noted that the Committee had not discussed how to categorize the treatment technologies. A member commented that many of the technologies could be placed into two or three groups of technology types, and that it might be possible to draw general conclusions about the technologies in those groups. A member commented that the technologies could be further grouped according to whether they had reliable data, some data, no data. A member questioned how much emphasis should be placed on evaluating the toxicological effects of biocides. Another member noted that toxicity testing had been conducted for systems that used biocides and that this information had been provided in the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) report. He noted that this report had been included in the materials provided to the Committee. A member commented that the Committee should provide advice to EPA on whether systems had toxicity concerns. Other members commented that for active substances that were well understood it might be possible for the Committee to provide a brief statement about toxicity in its report.

The Committee discussed the distribution of viruses and bacteria and whether they were invasive species of concern. A member commented that there was strong evidence of a biogeography of microorganisms and it was potentially possible to transfer genetic material in ballast water. A member commented that cholera had been transferred from South America to North America in vessel ballast water. Coast Guard staff commented that cholera had been included in the IMO standard because South American countries had wanted to move potable water in vessel ballast. He noted that test facilities had not been able to get permits to test cholera. A member suggested that zooplankton and phytoplankton standards be applied and indicated that he was not as concerned about bacteria numbers. Another member commented that he supported the use of bacteria standards because they could be used to conduct a quantitative test of the efficiency of ballast water systems. Another member commented that it was desirable to reduce microbes but it was a challenge to measure them.

Next Steps

The Chair thanked members for their comments and reviewed the next steps to develop the Committee's advisory report. She indicated that following the meeting, the Committee subgroups would hold separate teleconference meetings and develop initial responses to their assigned charge questions. She indicated that after the subgroups had developed their draft responses, the full Committee would meet again to deliberate on the draft responses. She indicated that, in addition to the next face-to-face Committee meeting, two Committee teleconferences would be held to discuss and reach agreement on the advisory report before it was sent to the chartered SAB for quality review. She indicated that the DFO would contact members to schedule subgroup teleconferences and the next Committee meeting. The meeting was then adjourned.

Respectfully Submitted:

Certified as Accurate:

/Signed/

/Signed/

Dr. Thomas Armitage,
Designated Federal Officer

Dr. Judith L Meyer, Chair
SAB Ecological Processes and
Effects Committee

NOTE AND DISCLAIMER: The minutes of this public meeting reflect diverse ideas and suggestions offered by Panel members during the course of deliberations within the meeting. Such ideas, suggestions and deliberations do not necessarily reflect consensus advice from Panel members. The reader is cautioned to not rely on the minutes to represent final, approved, consensus advice and recommendations offered to the Agency. Such advice and recommendations may be found in the final advisories, commentaries, letters or reports prepared and transmitted to the EPA Administrator following the public meetings.

ATTACHMENT A: COMMITTEE ROSTER

U.S. Environmental Protection Agency Science Advisory Board Ecological Processes and Effects Committee Augmented for the Ballast Water Advisory

CHAIR

Dr. Judith L. Meyer, Distinguished Research Professor Emeritus, Odum School of Ecology, University of Georgia, Lopez Island, WA

MEMBERS

Dr. E. Fred Benfield, Professor of Ecology, Department of Biological Sciences, Virginia Tech, Blacksburg, VA

Dr. Ingrid Burke, Director, Haub School and Ruckelshaus Institute of Environment and Natural Resources, University of Wyoming, Laramie, WY

Dr. G. Allen Burton, Professor and Director, Cooperative Institute for Limnology and Ecosystems Research, School of Natural Resources and Environment, University of Michigan, Ann Arbor, MI

Dr. Peter Chapman, Principal and Senior Environmental Scientist, Environmental Sciences Group, Golder Associates Ltd, Burnaby, BC, Canada

Dr. William Clements, Professor, Department of Fish, Wildlife, and Conservation Biology, Colorado State University, Fort Collins, CO

Dr. Loveday Conquest, Professor, School of Aquatic and Fishery Sciences, University of Washington, Seattle, WA

Dr. Robert Diaz, Professor, Department of Biological Sciences, Virginia Institute of Marine Science, College of William and Mary, Gloucester Pt., VA

Dr. Wayne Landis, Professor and Director, Department of Environmental Toxicology, Institute of Environmental Toxicology, Huxley College of the Environment, Western Washington University, Bellingham, WA

Dr. Thomas W. La Point, Professor, Department of Biological Sciences, University of North Texas, Denton, TX

Dr. Amanda Rodewald, Associate Professor, School of Environment and Natural Resources, The Ohio State University, Columbus, OH

Dr. James Sanders, Director and Professor, Skidaway Institute of Oceanography, Savannah, GA

CONSULTANTS

Dr. JoAnn Burkholder, Professor, Department of Plant Biology, Center for Applied Aquatic Ecology, North Carolina State University, Raleigh, NC

Dr. Andrew Cohen, Senior Scientist and Director, Biological Invasions Program, San Francisco Estuary Institute, Oakland, CA

Dr. Fred Dobbs, Professor and Graduate Program Director, Ocean, Earth and Atmospheric Sciences, College of Sciences, Old Dominion University, Norfolk, VA

Dr. Lisa Drake, Senior Scientist, Science Applications International Corporation, Key West, FL

Dr. Charles Haas, L.D. Betz Professor of Environmental Engineering, Civil, Architectural and Environmental Engineering, College of Engineering, Drexel University, Philadelphia, PA

Mr. Edward Lemieux, Director, Center for Corrosion Science Engineering, Naval Research Laboratory, Washington, DC

Dr. David Lodge, Professor, Biological Sciences, University of Notre Dame, Notre Dame, IN

Mr. Kevin Reynolds, Senior Marine Engineer, The Glostén Associates, Seattle, WA

Dr. Mario Tamburri, Associate Professor, Chesapeake Biological Laboratory, Maritime Environmental Resource Center, University of Maryland Center for Environmental Science, Solomons, MD, United States

Dr. Nicholas Welschmeyer, Professor of Oceanography, Moss Landing Marine Laboratories, San Jose State University, Moss Landing, CA

SCIENCE ADVISORY BOARD STAFF

Dr. Thomas Armitage, Designated Federal Officer, U.S. Environmental Protection Agency, Washington, DC

Ms. Iris Goodman, Designated Federal Officer, U.S. Environmental Protection Agency, Washington, DC

Materials Cited

The following meeting materials are available on the SAB website, <http://www.epa.gov/sab>, at the Ecological Processes and Effects Committee meeting page:

<http://yosemite.epa.gov/sab/sabproduct.nsf/MeetingCal/4C81DE70BB5ABD04852576D90054E925?OpenDocument>

¹ Federal Register Notice Announcing the Meeting (Vol 75 Number 125 Pages 37793-37794)

² Written Public Comments from:

- T. Maddox, Environmental Technologies Inc
- Susan Sylvester, Wisconsin Department of Natural Resources
- Koon S. Tang, New York State Department of Environmental Conservation

³ List of Public Speakers and copies of statements or presentation slides provided by the following speakers on the list:

- Bruce Bowie, Canadian Shipowners Association (copy of oral statement)
- Jon Stewart, International Maritime Consultants, Inc. (presentation slides)

⁴ Meeting agenda

⁵ Charge to the Committee

⁶ Agency Provided Background Material

- Background documents provided by the EPA Office of Water

⁷ Agency Briefing material

- Presentation by Deborah Nagle: Evaluating the Efficacy and Availability of Ballast Water Treatment Technology
- Presentation by Richard Everett: U.S. Coast Guard Ballast Water Discharge Standard - Overview of Notice and Proposed Rulemaking
- Presentation by Ryan Albert and Richard Everett: Capabilities of Shipboard Ballast Water Treatment Technology

⁸ Committee Developed or Provided Background Material

- Background Material on the subject of On-Shore Treatment of Ballast Water
- Ballast Water Transfer Study, Technical Feasibility with Associated Capital Costs. 2002. Prepared by The Glostén Assoc.; provided by K. Reynolds
- Document from The Glostén Associates; provided by K. Reynolds. Ballast Water Flow-Through Exchange, Best Practices Review. 2008
- Document from The Glostén Assoc.; provided by K. Reynolds. Sodium Hydroxide Feasibility Study, 2010
- National Science Foundation. 2003 "Engineering Controls for Ballast Water Discharge: Developing Research Needs." Report of a Workshop, Seattle Washington