Report from the

Great Lakes Ballast Water Collaborative Meeting: DULUTH

July 20 - 21, 2010

EPA Mid-Continent Ecology Division
Duluth, Minnesota

Prepared for: Wisconsin Department of Natural Resources (WDNR), Bureau of Watershed Management

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The goals of this two-day meeting were for participants to:

1. Gain a better understanding of the testing process/technology-verification procedures by touring the only freshwater testing facility in the world - the Great Ships Initiative (GSI);

2. Continue detailed discussions about Ballast Water Treatment System (BWTS) technology, verification strategies and policies; and

3. Contribute to one of three working groups convening formally for the first time, to support the specific information needs of the pending internal WDNR Ballast Water Treatment Technology Report.

INTRODUCTION

The Great Lakes Ballast Water Collaborative, as explained by Craig Middlebrook, Deputy Administrator of the Saint Lawrence Seaway Development Corporation (SLSDC), addresses real ballast water management needs with a degree of informallity. It brings key people together at key moments in a practical way with an approach that is thoughtful and inclusive.

The meeting began on July 20 at 8:30 a.m. with Middlebrook introducing Dr. Carl Richards, director of the EPA Mid-Continent Ecology Division. Richards welcomed a roomful of about 45 people and three phone-in participants. He explained that the research laboratory is best known for its ecology-focused investigations on midcontinent waters (including Great Lakes and Mississippi River) and toxicology work.

Paul Eger, Commissioner of the Minnesota Pollution Control Agency (MPCA) was impressed with the way the Collaborative has grown and progressed since the Detroit meeting, saying it "shows interest and momentum." He commented that SLSDC has exhibited outstanding leadership and commitment and that the MPCA's commitment remains strong.

Mark Burrows, scientist and secretary for the Council of Great Lakes Research Managers from the International Joint Commission (IJC) said the IJC was happy to provide support for the Duluth forum allowing the Collaborative to continue building a common knowledge base. He gave Joe Comuzzi, Commissioner to the Canadian Section of the IJC, credit in putting the meeting together both with leadership and financial support. Speaking of leadership, he said Lana Pollack recently became the Commissioner to the U.S. Section of the IJC.

Middlebrook praised Minnesota's leadership within the Collaborative, especially Jeff Stollenwerk of the MPCA and Dale Bergeron of Minnesota Sea Grant. He reminded participants that "we're not here to debate; we're here to talk about what is practical; what is doable." Verification and testing (focuses of the Montreal meeting) precipitated the Duluth meeting where participants would tour the Great Ships Initiative (GSI), the only freshwater ballast water treatment testing facility operating in the world.

The Collaborative agreed to focus on the needs of Wisconsin but understood that the information would go beyond the immediate questions posed by the State of Wisconsin. The future of ballast water treatment within the Great Lakes involves scientists from all over North America, federal governments of Canada and the United States, Great Lakes state and provincial governments, vendors, vessel owners, non-governmental groups, and regulators. The Ballast Water Collaborative includes a cross-section of all of these stakeholder groups.

TYPE-APPROVAL

Federal “type-approval” for ballast water treatment systems dominated the first informational segment. Putting ballast water treatment standards aside, Commander Gary Croot, Chief of the Environmental Standards Division of the U.S. Coast Guard (USCG), spoke about steps and requirements for type-approval.

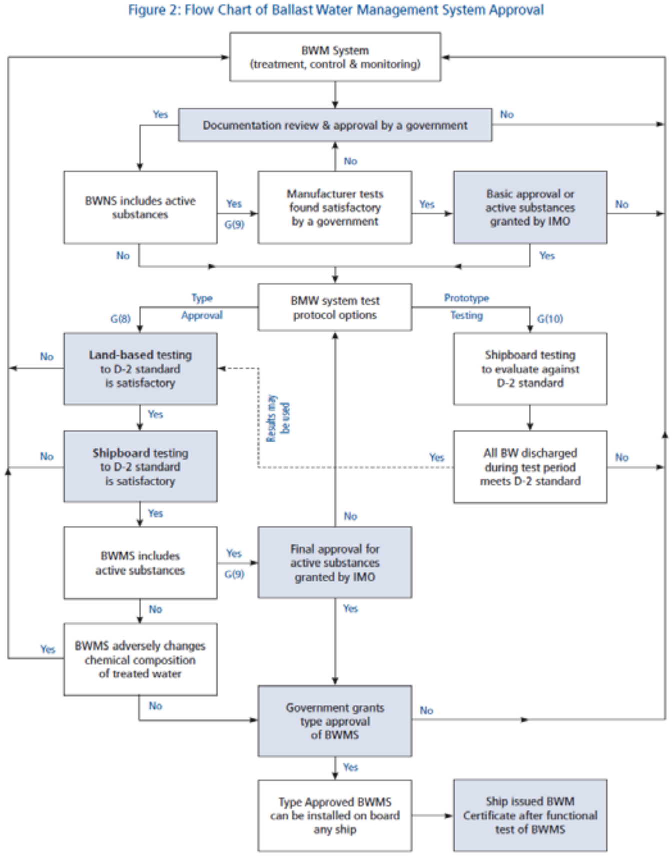
He explained that all critical equipment onboard vessels is type-approved by the Flag Administration (for example, in the U.S., the USCG, or an accepted three-party authority is required to type-approve equipment). Some international challenges are rooted in the fact that some Flag Administrations rely on entities acting on their behalf making quality assurance and quality control questionable.

Requiring that important components of a ship be type-approved saves costs and time in the long run. Cmdr. Croot used life jackets as an example. "It makes much more sense to type-approve a design and then spot-check the manufacturing plants, rather than test every item made," he said. To gain type-approval for ballast water treatment systems (BWTS), manufacturers must balance three criteria:

1. Is this system effective in meeting the standard?
2. Is the system safe for the crew and the vessel?
3. Is the effluent safe for the environment?

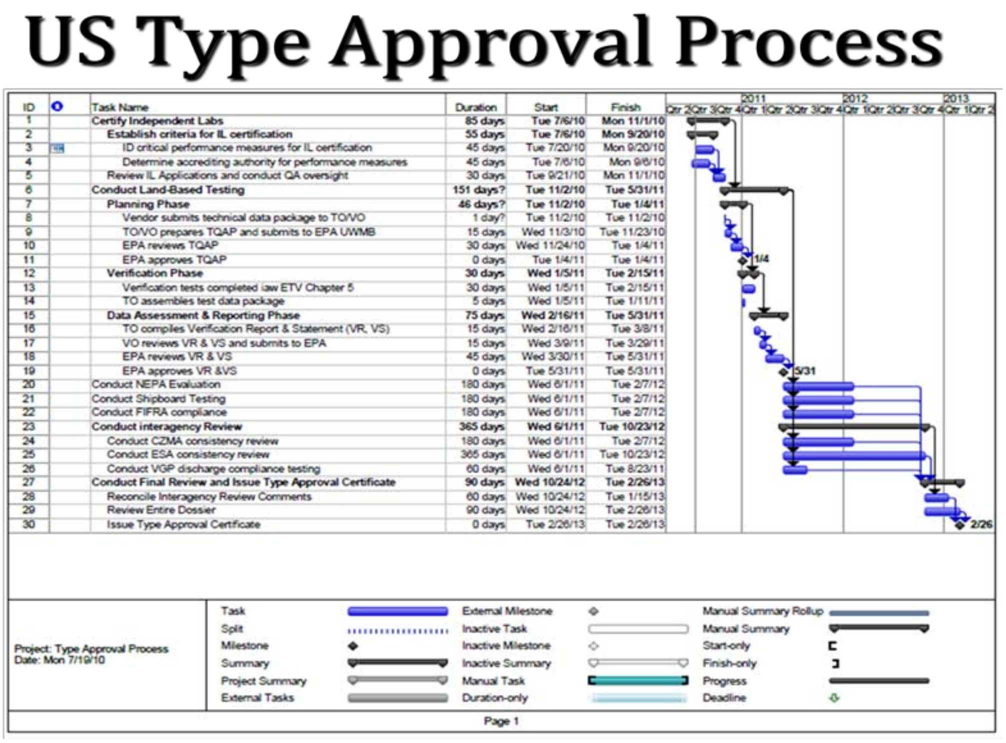
Cmdr. Croot referenced a linear flow chart out of *Lloyd's MIU Handbook of Maritime Security* for type-approving a BWTS. Explaining that the type-approval process was not quite that simplistic, he discussed a more complex process flow as diagrammed in an American Bureau of Shipping (ABS) guide released in March 2010 (Fig. 2).

Figure 2: Flow Chart of Ballast Water Management System Approval



This discussion led into a review of the USCG approval process (see “US Type Approval Process” figure below). After joking that vendor applications should be sent to Dr. Richard Everett, Environmental Protection Specialist, Environment Standards Division of the USCG, for a “yes or no” answer, Cmdr. Croot explained that type-approval was not just a USCG process but includes the Environmental Protection Agency (EPA) (Office of Water, Office of Chemical Safety and Pollution Prevention), the National Oceanic and Atmospheric Administration, and the National Marine Fisheries Service. The BWTS must also pass scrutiny under the:

- National Environmental Policy Act (NEPA)
- Coastal Zone Management Act (CZMA)
- Endangered Species Act (ESA)
- Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)


US Type Approval Process

ID	Task Name	Duration	Start	Finish
1	**Certify Independent Labs**	85 days	Tue 7/6/10	Mon 11/1/10
2	**Establish criteria for IL certification**	55 days	Tue 7/6/10	Mon 9/20/10
3	ID critical performance measures for IL certification	45 days	Tue 7/20/10	Mon 9/20/10
4	Determine accrediting authority for performance measures	45 days	Tue 7/6/10	Mon 9/6/10
5	Review IL Applications and conduct QA oversight	30 days	Tue 9/21/10	Mon 11/1/10
6	**Conduct Land-Based Testing**	151 days?	Tue 11/2/10	Tue 5/31/11
7	**Planning Phase**	46 days?	Tue 11/2/10	Tue 1/4/11
8	Vendor submits technical data package to TO/VO	1 day?	Tue 11/2/10	Tue 11/2/10
9	TO/VO prepares TQAP and submits to EPA UWMB	15 days	Wed 11/3/10	Tue 11/23/10
10	EPA reviews TQAP	30 days	Wed 11/24/10	Tue 1/4/11
11	EPA approves TQAP	0 days	Tue 1/4/11	Tue 1/4/11
12	**Verification Phase**	30 days	Wed 1/5/11	Tue 2/15/11
13	Verification tests completed iaw ETV Chapter 5	30 days	Wed 1/5/11	Tue 2/15/11
14	TO assembles test data package	5 days	Wed 1/5/11	Tue 1/11/11
15	**Data Assessment & Reporting Phase**	75 days	Wed 2/16/11	Tue 5/31/11
16	TO compiles Verification Report & Statement (VR, VS)	15 days	Wed 2/16/11	Tue 3/8/11
17	VO reviews VR & VS and submits to EPA	15 days	Wed 3/9/11	Tue 3/29/11
18	EPA reviews VR & VS	45 days	Wed 3/30/11	Tue 5/31/11
19	EPA approves VR &VS	0 days	Tue 5/31/11	Tue 5/31/11
20	Conduct NEPA Evaluation	180 days	Wed 6/1/11	Tue 2/7/12
21	Conduct Shipboard Testing	180 days	Wed 6/1/11	Tue 2/7/12
22	Conduct FIFRA compliance	180 days	Wed 6/1/11	Tue 2/7/12
23	**Conduct interagency Review**	365 days	Wed 6/1/11	Tue 10/23/12
24	Conduct CZMA consistency review	180 days	Wed 6/1/11	Tue 2/7/12
25	Conduct ESA consistency review	365 days	Wed 6/1/11	Tue 10/23/12
26	Conduct VGP discharge compliance testing	60 days	Wed 6/1/11	Tue 8/23/11
27	**Conduct Final Review and Issue Type Approval Certificate**	90 days	Wed 10/24/12	Tue 2/26/13
28	Reconcile Interagency Review Comments	60 days	Wed 10/24/12	Tue 1/15/13
29	Review Entire Dossier	90 days	Wed 10/24/12	Tue 2/26/13
30	Issue Type Approval Certificate	0 days	Tue 2/26/13	Tue 2/26/13

The type-approval process in the U.S. is time consuming. Cmdr. Croot said that if a vendor started the process in July 2010, it would be early 2013 before the BWTS could be type-approved (assuming an aggressive schedule). In other countries, type-approval also takes about 18-24 months.

Cmdr. Croot talked about the USCG’s Shipboard Technology Evaluation Program (STEP). STEP is a voluntary, no-fee program that facilitates the development of ballast water management system technologies by granting participating vessels a waiver from future ballast water discharge standard regulations while their BWTS operates satisfactorily. By providing this opportunity for BWTS vendors to partner with vessel owners, STEP encourages early installation of BWTS and expedites the onboard testing needed for final BWTS type-approval.

The STEP workshop to be held on July 22, 2010, in Duluth, Minn., will encourage vessel owners to install experimental BWTS onboard and encourage early installation. The USCG hopes to streamline this process through the Collaborative, especially since the ships must receive approval from every state affected. In California, if the system and ship are in the STEP program, the state cooperates. The USCG wants the same cooperation from the Great Lakes states and provinces.

To conclude his presentation, Cmdr. Croot reiterated that:

- In the U.S., type-approving a BWTS will take at least 18-24 months AFTER independent laboratories for testing are established;
- Fully marine saltwater test facilities do not exist in the U.S.;
- Much of the type-approval process is outside the purview of the USCG; and
- The USCG is evaluating procedures to accept foreign type approved systems for operation in U.S. waters.

VERIFICATION AND VALIDATION

The discussion following Cmdr. Croot's presentation included a reminder that quality assurance and quality control are "hugely important and need to be handled with rigor." QA/QC could be assessed onboard vessels like the California Maritime Academy's training ship *Golden Bear*, which was recently outfitted to test ballast water treatment prototypes. *Golden Bear* and the Maritime Environmental Research Center (MERC) barge (being developed by Dr. Mario Tamburri, research associate professor at the University of Maryland and director of MERC) are moving toward full marine testing. The USCG wants BWTS to be installed and fully tested on ships (hence STEP) and works closely with all three BWTS testing facilities in the U.S. (MERC, GSI and *Golden Bear*).

Dialog among meeting attendees revealed that independent testing laboratories must wait for final regulations that set requirements for treatment efficacy, just as do BWTS vendors and shippers, before they can finalize their testing schemes and protocols. Laboratories need to be independent of vendors. However, on a global scale that independence is not always present and might create challenges when vendors and shippers plan to operate in North American waters. Independent laboratories don't approve BWTS, Flag Administrations do based-on outcomes from BWTS tests conducted at independent labs. The USCG is looking into a process for accepting foreign approvals BUT they are having difficulty with "reporting-transparency" and therefore Quality Assurance/Quality Control. Manufacturers of BWTS should develop shipboard testing protocols so that users can easily check to verify that systems are working properly. The USCG might hire a contractor to conduct tests because they don't have the personnel or expertise to do the testing.

Environmental Technology Verification (ETV) Protocols for independent lab testing are drafted and available for public comment (http://www.epa.gov/etv/etvoice0310.html). Sometime following EPA's review of the ETV Protocols, the USCG plans to release the ballast water management regulations for both Phase I and Phase II simultaneously.

It was suggested that within the FIFRA process, the "go-to" person in the multiple agencies involved should be made accessible in a list. At this time, this information is not readily available, making the process cumbersome and time consuming.

Chris Wiley of Fisheries and Oceans Canada said that Transport Canada, like the USCG, will not "be out there looking at ships." He explained that Canada is developing a process for type approving BWTS based on G8 and G9 IMO guidelines. Transport Canada is encountering issues that are similar to those challenging the USCG, i.e., verifying the performance of systems that have been type-approved by other Flag Administrations. Another issue is ensuring that systems have been tested under conditions representative of what vessels will encounter, such as the fresh cold water of the Great Lakes. These conditions can have a significant impact on the efficacy of a system that has been tested for type approval in warm, saline water.

SHIP CLASSIFIATION

Bill Lind, Marine Technology and Business Development Director for ABS Americas, reviewed the type-approval process from ABS's perspective. He said that ship classification grew out of the need for insurance and dates back to the sixteenth century. Lloyd's Register printed the first *Register of Ships* to give both underwriters and merchants an idea of the condition of the vessels they insured and chartered. ABS is like Lloyd's Register. Founded in 1862, the not-for-profit ABS has 3,000 employees and 183 offices in 72 countries. It helps insure 11,000 commercial ships, boats, and barges; military vessels; offshore rigging; and yachts. ABS's mission is to protect lives, property, and the environment.

Lind said that ship classification is third-party certification and that classification is a life-cycle process, which certifies adherence to a recognized state of technical standards. Generally, certification covers a ship or marine structure as a whole, but it may cover a single piece of equipment.

In addition to addressing pollution, Lind said vessel owners have to work toward energy efficiency. An Energy Efficiency Design Index (EEDI) chart is currently being hashed out at an international level, he said. What all classification systems try to do is to keep pace with regulatory updates.

In June 2010, ABS published a *Ballast Water Treatment Advisory* to assist the industry in better understanding the evolving ballast water management (BWM) and treatment regulations, with an emphasis on providing practical guidance for shipbuilders, owners, and operators on how to prepare for the selection, installation, and operation of an appropriate treatment system for different ship types. The *Ballast Water Treatment Advisory* is divided into five sections:

1. Regulatory developments;
2. Treatment technologies;
3. Considerations for system selection;
4. Evaluation checklists; and
5. A technical summary of the principal systems currently available on the market.

Lind provided an overview of the *Advisory*, which included insights such as: the type of BWTS a shipper picks will depend on the ship (consider space to install and maintain, storage of chemicals, installation ease, flow rates and pressure drops, supply of spare parts and chemicals, training and documentation, life cycle costs). Additional considerations are necessary if the BWTS uses active substances or chemicals. For existing vessels, an increased gross tonnage tax may be levied. Another problem is that vessels may experience power failures once a BWTS is installed. Lind said that there are an increasing number of "dead ships" because of overall increasing demands on power.

Lind concluded by reiterating that "type-approval" means different things to different people. He said, "We second what the Coast Guard is saying; be careful about what information you are using…does it really fully comply?"

NOTE: The ABS Advisory is a substantive resource for information about the current state of ballast water management technologies. Copies of the Advisory are available from ABS offices or are available for download from the ABS Web site within Resources, Booklets & Bulletins (see: www.eagle.org).

VENDOR PERSPECTIVE (Ecochlor®)

Charles (Charlie) Miller, CEO from Ecochlor®, Inc., stepped to the microphone to report that the company has installed full-scale systems onboard working vessels and that Ecochlor's BWTS have been tested by Lloyd's Register and ABS for type approval on behalf of Flag Administrations. Also, the first commercial cargo vessels accepted into USCG's STEP program carry large-scale Ecochlor systems. (It took three years, National Environmental Policy Act (NEPA) review included, but Ecochlor was the first BWTS through the process.)

Ecochlor manages ballast in two steps: pre-filtration and treatment with ClO_2 (chlorine dioxide). Only the pre-filtration components need to be installed in close proximity to the ballast pumps. According to Miller, the scalable system has a small footprint and consumes minimal power. Hundreds of these types of filtration systems are in use within marine environments around the world (although not specific to BWTS). Miller reported that the test results exceeded the U.S. proposed standard (based on values being below the detection limit of the testing method). Recently, shipboard testing of Ecochlor by German scientists found no viable organisms after 24 hours. Purate (a precursor in the formation of ClO_2) supplies, and service ports are available worldwide.

All systems need a pre-filtration component (the Royal Netherland Institute for Sea Research testing facility found that a 40-micron filter was successful). The ClO_2 treatment can be installed where it is convenient. Miller reported that ClO_2 is highly effective at killing all organisms and biofilm in ballast water. "It is a proven and well-understood technology that does NOT produce chlorine," he said. Dosage is not affected by organics or salinity. ClO_2 is a highly soluble gas in water and readily disperses.

At the end of the presentation, a member of the audience asked if there might be concerns about corrosion on the uncoated ballast tanks of Great Lakes ships. Miller said the chlorine was gone within about six hours so exposure would be limited. Another audience member reminded the group that ballasting may occur many times within a day or two on a laker, whereas ocean-going vessels might ballast once a month. This brought up the unanswerable (at this time) question of how much purate and acid (to create ClO_2) might be needed.

REGULATORY PERSPECTIVE (Minnesota Pollution Control Agency)

Jeff Stollenwerk, Acting Manager of the Industrial Land and Water Quality Permits for the Minnesota Pollution Control Agency, talked about the regulatory aspects of ballast water management in the Great Lakes. He began with a chart (shown below) illustrating how the standards for ballast water are "all over the board for states, and the U.S. and Canadian governments."

St. Lawrence Seaway/Great Lakes Biological Discharge Standards

Government Agency	BW Discharge Standard for New	BW Discharge Standard for Existing
Transport Canada	IMO D-1 and D-2	IMO D-1 and D-2
USCG, USEPA	BWE/BMPs	BWE/BMPs
SLSMC, SLSDC	BWE (30 ppt salinity), SWF	BWE (30 ppt salinity) SWF
Michigan	Technology	Technology
Illinois, Minnesota, Pennsylvania	IMO in 2012	IMO by 2016
Ohio	IMO in 2016	NA
New York	1000x IMO in 2013	100x IMO by 2012
Wisconsin	100x IMO by 2012	100x IMO by 2014

BWE=ballast water exchange; SWF=saltwater flush; BMP=best management practices

Due to regulatory inconsistencies, the state of technology, and timeframe, Stollenwerk felt that some vessels currently transiting the Great Lakes will likely not be able to achieve compliance. He said that, especially given the difference between marine and freshwater environments, ballast water discharge standards will likely need to be more stringent than the IMO D-2 Convention to meet state water quality standards under the Clean Water Act. The EPA and USCG are working with the National Academies (http://www8.nationalacademies.org/cp/projectview.aspx?key=49224) to develop an approach to establish environmentally protective standards. Stollenwerk thought they might recommend a different standard than that proposed by the IMO. He said, "What we understand about introduction risks and propagule pressure will force scientists to make pretty conservative conclusions. I wouldn't be surprised to see standards close to California standards."

Stollenwerk suggested that states may need to develop enforcement strategies to address non-compliance. He could envision that some vessel owners might refuse to operate in violation of ballast water regulations. Ship owners are concerned about having to make decisions *now* in order to meet some of the proposed deadlines for compliance.

The traditional tools for resolving this type of sticky situation (rulemaking/permitting; legislative; litigation) may take 3-5 years within the EPA's framework. To expedite better practices for ballast water management in the Great Lakes, Stollenwerk pitched the idea of developing compliance agreements between governments and shippers, possibly through the Great Lakes Ballast Water Collaborative. He thought that crafting a negotiated enforceable document to achieve compliance with respect to challenging regulations could make progress toward reducing the spread of aquatic invasive species while complying with discharge standards. As a first-step, he thought that a negotiated agreement could be developed to ensure the next vessels within the USCG's STEP program are in compliance with all applicable regulations.

The group recognized the advantages of putting BWTS onboard vessels sooner rather than later (BWTS research and development, environmental health). Scott Smith, Chief of the Ecology Section of the U.S. Geological Survey Western Fisheries Research Center, suggested an approach similar to that adopted by the State of Washington: if the USCG approved a BWTS, the state will accept it also. A BWTS vendor didn't think a negotiated agreement was an efficient approach; this thought was challenged by Bruce Bowie, President of the Canadian Shipowners Association. Jon Stewart, representing International Maritime Technology Consulting, added that while a negotiated agreement could serve as an interim step, it would not be a blanket solution.

Others agreed.

A STUDY OF BALLAST WATER MOVEMENT IN THE GREAT LAKES

Canadian Shipowners Association representatives Bruce Bowie and Azin Moradhassel presented research results prepared by Canadian Steamship Line's (CSL) Kirk Jones, Caroline Denis, and Joe Lewis. The topic concerned the potential risk of transferring invasive species within Great Lakes ballast water and workable solutions for existing lakers.

Referencing a handout, Moradhassel explained the three goals of the CSL study:

1. To determine how much ballast water is being moved between domestic ports;
2. To determine what aquatic invasive species (AIS) are moving; and
3. To define the potential risk moving of AIS.

The researchers drew from the Vessel Transit Study[1] to create a database of ballast water movement between ports, and to identify potential AIS-donor and AIS-receiver ports. They

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[1] Rup, M. P.; Bailey, S. A.; Wiley, C. J.; Minton, M. S.; Miller, A. W.; Ruiz, G. M.; MacIsaac, H. J., 2010. Domestic ballast operations on the Great Lakes: potential importance of Lakers as a vector for introduction and spread of nonindigenous species. Canadian Journal of Fisheries and Aquatic Sciences 67(2): 256-268.

found that the CSL fleet of 18 vessels moved approximatly 8.5 million metric tons of water between Great Lake ports in the 2009 shipping season. A majority of this volume went to seven ports (CSL Ballast Receiver Ports chart) from seven donor ports (CSL Ballast Donor Ports chart).

Moradhassel then talked about the second goal of compiling a database of AIS in Great Lakes and how the AIS database would be used to cross-reference the presence of AIS in ports with the ballast water movement database to model the probablity of further AIS introductions (goal 3). The model can be broken down into: per voyage, per load port, per light port, per species, and per vessel. The researchers found that the three invasive species most likely to be spread in ballast water are: fishhook waterflea, rudd, and bloody red shrimp.

Moradhassel mentioned Lake Superior in particular. She said that preliminary results suggest that CSL vessel transits have the potential to move six species (3 percent of existing AIS) into Lake Superior through the Hamilton-Superior trade route. However, despite having moved large volumes of ballast water into Lake Superior ports over a long period of time, there is no evidence of AIS transfers from load ports. She reasoned that maybe this is because Lake Superior is a "cold spot (Note: see Grigorovich et al, 2003[2])?"

CSL intends to improve the model, use it as a tool to examine risk of transfer questions, and to potentially develop a "Made in the Great Lakes" solution for addressing AIS transfer risk for existing vessels.

CSL was congratulated for the courage to engage in this study. Dr. Sarah Bailey, Research Scientist with Fisheries and Oceans Canada, said the CSL model was a useful tool and that in addition to shipping companies reporting transfer data, scientists need to identify what is in each port to begin with. Bowie asked that Collaborative members provide comments to Middlebrook. He said that the CSL identified its potential for moving AIS, but information about propagule pressure and infestation risk is limited. They would like to determine workable technologies that address the greatest risks. Middlebrook said that while everyone is looking for a BWTS that works in cold fresh water, the interim measures being pursued, like the information generated through the CSL study, are laudable.

From 11:30 a.m. onward, many Collaborative participants toured the Superior Midwest Energy Terminal to better understand the volume of cargo being moved by Great Lake vessels and the importance of cargo velocity (hence the demand for high ballast flow rates). They also toured the GSI facility (the only fresh water BWTS testing facility in the world, located in the Superior Harbor), and some viewed the layout and ballast tanks of a working vessel at the Duluth Seaway Port Authority.

DAY TWO

Adolph Ojard, Executive Director of the Duluth Seaway Port Authority, interjected as the meeting opened on July 21, that he felt it important to give some perspective concerning the activity levels in the Port of Duluth/Superior and the general activity of maritime commerce in the Great Lakes. Ojard reported that the Port of Duluth-Superior experienced activity involving eight different ships in the previous 24 hours: the McCarthy left, the St. Claire, American Century, and the White arrived and departed, the Presque Isle was loading grain, a ship destined for Montreal was loading wheat, a ship with a byproduct of ethanol used for animal feed was

[2] Grigorovich, I.A., A.V. Korniushin, D.K. Gray, I.C. Duggan, R.I. Colautti, and H.J. MacIsaac. 2003. Lake Superior: an invasion coldspot? Hydrobiologia 499: 191–210.

going to Turkey, and a ship destined for Spain was loading beet pulp; plus, 1,000 cars of coal and grain had been through.

MORE ON SHIP CLASSIFICATION AND BWTS

Graham Greensmith, Lead Specialist of External Affairs from Lloyd's Register, spoke to the Collaborative via teleconference. He addressed BWTS from an insurer's perspective. The first point he made was that the vendor, Flag Administration, a recognized organization (RO) acting for the administration, a land-based testing facility, and a ship need to be involved in ensuring that a treatment system is safe and effective. While the Flag Administration is responsible for certifying a system, often they pass the process to an RO. The manufacturer must apply for approval, which requires land-based and shipboard testing.

Greensmith discussed using the International Maritime Organization's (IMO) G8 guidelines from a practical point of view. He said that the guidelines are complex and open to interpretation. IMO type-approval takes about 18-24 months to complete. He suggested that in light of experience, it may be time to update the guidelines, but in the meantime, using them requires coordination, good relationships, and all parties to fully understand the process and their responsibilities.

Responding to audience questions, Greensmith said that ideally, vetting and verification procedures would be conducted through a quality assurance program within the IMO. As BWTS technologies are developing, so should the type-approval process. Greensmith said he understands that some of the BWTSs won't work in fresh water but didn't have information to comment on what might work in the Great Lakes.

Allegra Cangelosi, Senior Policy Analyst with the Northeast Midwest Institute, said the U.S. testing facilities are conducting IMO-consistent tests and developing an information base to determine differences between BWTS performance in fresh, brackish, marine waters. She said that GSI would like to have a relationship with Lloyd's Register.

Dr. Richard Everett commented on the distinction between independent labs and test facilities. By the Coast Guard's definition, he said that an "independent lab" is more of an oversight organization responsible for providing oversight to test facilities. He said that GSI is not necessarily an independent lab, but that it could be. ABS could be, and maybe it is for some things. Engineering issues and efficacy tests may take place at a totally different facility. He recommended that Collaborative participants keep in mind that independent laboratory representatives may not even be in the room and that some of the components involved in BWTS are not at the table (engineering labs, for example). He said that there needs to be some self-organization for independent labs to line up different testing facilities and that most of this organization is outside the USCG purview.

MORE ON VERIFICATION AND VALIDATION

For the next hour, Dr. David Reid, a consulting scientist to the SLSDC, facilitated a panel discussion involving the BWTS testing capabilities in the U.S. Panelists consisted of Allegra Cangelosi, Dr. Mario Tamburri (by telephone), and Dr. Lisa Drake. Cangelosi is director of the GSI test facility located in Superior, Wis.; Dr. Tamburri is Director of the MERC test facility located near Baltimore, Md., and Dr. Drake is lead scientist for ETV (Environmental Technology Verification) test protocol development at the Naval Research Laboratory, Key West, Fla. GSI and MERC are BWTS type-approval test facilities and also conduct test protocol development and evaluation; the NRL facility does not conduct BWTS type-testing, but is under contract with the U.S. Coast Guard to develop the ETV test protocols, which are designed to verify manufacturer claims of system performance. The session was designed to continue discussing, not rehash, the information and progress made during the Montreal Ballast Water Collaborative meeting (see the Montreal Report for details). Dr. Reid listed four themes for the discussion:

- Status of protocol development (domestically and internationally);
- Challenges and opportunities for achieving statistical confidence in results at a given land-based test site;
- Opportunities to optimize the predictive accuracy of the overall type-approval process outcomes of BWTS performance in the real world; and
- Database development and management to support review and revision (adaptive management).

Major outcomes of the Montreal meeting with respect to this panel include:

- A review and assessment of verification facilities for BWTS;
- Recognition that there are currently no uniform standards for BWTS test protocols;
- An agreement that quality assurance and quality control references and standards are necessary; and
- An understanding that validation is enormously challenging because of sample volumes and statistics (challenges associated with statistical confidence).

Dr. Drake gave an update on developing the Environmental Technology Verification (ETV) protocols to be adopted by federal agencies saying that they have cleared the National Science Foundation and are pending clearance by the EPA (Research and Development Laboratory), hopefully in August 2010. She acknowledged the persistent challenges associated with sample volume and statistics, and the difficulties associated with going from land-based testing to shipboard testing. Extrapolating land tests to ship performance is not necessarily a straightforward calculation. She suggested a data repository and some associated database management could help resolve issues regarding predictiveness. A central database of BWTS test performance data measured in a systematic way might include: salinity, type of ecosystem, and temperature.

The big change from earlier drafts of the ETV protocols relates to sample volumes; very large volumes appear to be necessary to verify that IMO standards are being met (Dr. Drake noted that to achieve statistically acceptable confidence that the Wisconsin standards are being met, phenomenal volumes of water would have to be sampled). In earlier drafts of the ETV protocols, 3-cubic-meter samples were considered sufficient. Now 5-, 10-, and 30-cubic-meter samples are called for. It might be possible to use smaller volumes if samples can be concentrated.

Determining viability was also revisited since it is difficult to determine if protists are living; the drafted ETV protocol calls for the coupling of two vital-fluorescence stains. An EPA Science Advisory Board (SAB) committee is reviewing the technology to determine if it is possible to verify that a BWTS working onboard a ship is meeting IMO standards. This verification is a critical challenge for regulators.

Shipping industry representatives wondered how going beyond validation to verification would happen. Dr. Drake said that she is discussing this issue with Fisheries and Oceans Canada scientists (Sarah Bailey et al.) but that if any parcel of water exceeds the standard, it won't pass verification if regulators are onboard. She thought that maybe ports could take a first cut and if the BWTS passed, then it would be approved; if it didn't, then further testing would be required. Dr. Tamburri said that with such large volumes involved, it would be most effective to look for gross violators rather than vessels that are barely under or barely over the standard.

Cangelosi said that the forthcoming ETV protocol is likely to be an organizing force for ballast water management in the U.S. She said, "It is a first 'ante' of how type-approval and compliance testing could take place." How well the type-approval testing predicts how well a BWTS will perform on a ship in operation will remain enigmatic for several more years. Cangelosi continued, "The first ante can barely be informed by the stuff that happens after it. I suggest that this group produce a database so that this challenge can be easily addressed. I don't know if there is going to be a gap, but we would be wise to keep the potential disconnect in mind. We might review past lessons about performance in the real world verses lab results." She said regulators must be prepared to make changes in the protocol to tighten the gaps as time goes on.

In the myriad conditions in which BWTS will need to operate, it was suggested that a prudent ship-owner or environmental advocate would look for the system that had been tested in as many conditions as possible. (Presently, a BWTS that has been vetted under controlled conditions is probably the best that is possible; hedge your bets.) Cangelosi commented that certain BWTS vendors are going beyond bare minimum (inspired by shipper's requests) by having multiple tests done then aggressively marketing their double or triple land-based tests. Dr. Tamburri questioned ways to compare complete sets of data. Cangelosi said, "Yeah, that's why the database doesn't exist already." Dr. Drake suggested holding a workshop to harmonize methods, but reminded the group that the statistics would be tough to get around. "Sample size will have to be a factor in the database," she said.

Dr. Reid asked Cmdr. Croot if the STEP program was gathering data that could contribute to this database and if compliance would be monitored under different conditions. Cmdr. Croot answered with an emphatic, "Yes!" Ships currently in the STEP program travel from Hawaii to the West Coast, and one travels to Asia. They experience significant operating ranges but one of the challenges is finding examples of ships that don't comply; for example, in a test conducted in the United Kingdom, the uptake water was already in compliance before any treatment happened. The panelists agreed that validation and type-approval testing protocol should include language stating the uptake water must exceed the IMO standard.

Cangelosi responded to a question about how to encourage regulators to collect information for adaptive management by saying, “despite the vagaries of biology, we need a solid information base and we have to hope that regulators access it. Those of us here need to help develop this information source and put it in the right hands.”

Stewart (International Maritime Technology Consulting) said that vendors would participate on an industrial level but that the group should remember that BWTS manufacturers are not non-profits. He said, “Vendors take tremendous financial risks to develop BWTS. They don’t get much in the way of kudos, but they definitely get punished for failure. I don’t know of any business that doesn’t want to exceed IMO standards; they want to go beyond compliance testing.” He suggested that technology developers could contribute beyond-compliance testing information to support the BWTS database being discussed.

Wiley was asked to comment on Canadian ships with BWTS onboard that are arriving with non-compliant numbers of living organisms in their ballast water. He said he couldn’t find a correlation between failure and the conditions. “Manufacturers are working to ensure that their systems perform under all conditions,” he said. “Manufacturers are working hard to make BWTS work.”

Dr. Bailey said, “Simply, those systems were not tested in freshwater.” Vendors are required to test in two of three conditions: saltwater, brackish, or freshwater. Most are tested in brackish and saltwater. “Ships are a terrible place to do science,” continued Dr. Bailey suggesting that maybe there is a need for more laboratory testing in different conditions even before ship-board testing starts. Important variables that are possibly skimmed over during testing include: temperature, turbidity, and salinity. Cangelosi agreed saying, “…leaving these variables to shipboard testing is very, very risky.”

Land-based testing facilities in the U.S. are improving. The GSI works to make BWTS testing easy and cost-effective. They cooperate with MERC where systems can be tested using brackish water and are subsidized by federal funds. Dr. Drake said that the purpose of land-based testing is to get information in a controlled condition and that the purpose of shipboard tests is to see if the system rattles apart. Ships can experience tremendous physical motion with waves bashing and engines churning in hot, humid environments. She said that it is not ETV’s responsibility to test at multiple temperatures and salinities. ETV protocols use salinities that are different than IMO standards to encourage testing in different conditions.

“Don’t forget the vendors and what they have to go through!” said a Collaborative participant. Many salinity and temperature questions can be addressed in lab and some of the questions don’t have to be answered everywhere. Water temperature influences decay rate. Salinity is more than a chemical issue; it is biological also. BWTS with a filtration component (i.e. most of them) will likely function differently in fresh and saltwater.

Dr. Everett (USCG) explained that ETV testing is undertaken and designed to verify a manufacturer's claims. He said that ETV protocols were developed through a Memorandum of Understanding between the USCG and the EPA. EPA's stakeholder process identified the need for protocols, which gave the USCG an opportunity to tap a skill set not typically available to them. "However, there is a difference between ETV protocols and the type-approval process," he said. ETV protocols might have nothing to do with type-approval. If a manufacturer makes a claim, ETV protocols lay out a plan for how the claim should be checked. Dr. Everett said that it is easy to confuse the two, especially since the USCG wants to make use of the early spadework (ETV) to facilitate the type-approval process.

Dr. Reid summarized the panel discussion about the type-approval process. He recalled the concern that land-based testing may not translate well to shipboard performance due to the movement and motion of a ship. He also said that it was important not to confuse ETV protocols with type-approval protocols. "Verification and validation testing are more complex than we might have outlined for simplicity," he concluded.

Dr. Tamburri wrapped up with the comment that although U.S. land-based testing facilities are coordinating their efforts, the diversity of testing around the world means that information is not necessarily going to be collected and reported consistently. Communication among scientists is crucial in ensuring that the information is comparable. Recent comparisons between GSI and MERC indicate that different species are responding to the same system in similar ways. North Sea researchers are coordinating to create harmonization of projects, which is being extended to the U.S.

The Ecochlor CEO asked, "What is the incentive for manufacturers to go through the ETV program when USCG will require much more? You could bankrupt yourself just going through one set of tests?" Dr. Everett responded saying that the USCG intends to reference ETV protocols in type-approval. The whole point was to, at a minimum, develop protocols to evaluate BWTS to IMO. "If it plays out how I think it will, part of the type-approval application would require that a vendor test their BWTS with ETV protocols to IMO standards," he said. The difference between ETV protocols and type-approval is illuminated in a situation where a vendor might want to make claims beyond what the USCG cares about (i.e., ease of use, repairs). Ship-owners use ETV to verify vendor claims, sort of like Consumer Reports.

A Collaborative participant recalled hearing that the USCG might not require a vendor to get type-approval for short runs (as short as 10 hours before reballasting) and at unusual pumping rates. Dr. Everett said that if a ship needed special considerations, that information would be specified in the type-approval document.

Cmdr. Croot answered a question about the USCG's ability to force a ship owner to install an approved system. He said, "Cost is not a factor in type-approval; footprint is not a factor. Those questions are of practicability." Type-approval has NOTHING to do with "practicability," but the USCG is required to do this, and is in the process of reviewing BWTS "practicability" this week.

Bill Lind suggested that since the USCG has done regulations for a long time (i.e. fire protection information) that maybe they could implement ballast water regulations in the same way.

Susan Sylvester, Chief of the Permits Section of the Bureau of Watershed Management with the Wisconsin Department of Natural Resources, discussed the practicability review in Wisconsin. She expects the working groups to solve some basic questions about feasibility and if BWTS technology is practical at this time. Dave Adams (New York DEC) said the practicability review in New York is limited by 401 certification requirements and that all the states he has been working with have some form of a practicability review.

WORK GROUP BREAKOUT SESSIONS

At 10:30 a.m., Sylvester described the process and expectations for the breakout sessions. (See *Description of process/expectations for work group breakout sessions* handout.) The groups were tasked with working together to turn out specific products. Sylvester explained that the sessions were designed to help address Wisconsin's Ballast Water General Permit and the challenges associated with it. She appreciated that the EPA is in the process of determining feasible national discharge standards and regrets that those numbers won't be available before Wisconsin's December 2010 deadline for making a decision. Like most, she thinks a proposed rule by Coast Guard would be ideal.

Dale Bergeron, Maritime Transportation Specialist for Minnesota Sea Grant, said that since uncertainty percolates the issues, the workgroups should "not look for perfect, but instead look for available." He reminded the group that the discussions should reflect positions, not personal opinions, he asked the groups to focus at a "high level," and reminded participants that the dialogs were going to be turned into general notes, not testimony.

The Breakout Sessions were as follows:

> Work Group 1: Identification of "Available" Ballast Water Treatment Systems "Rated" to Meet or Exceed 100x IMO. (Facilitator: Dr. Marvourneen Dolor)
>
> Work Group 2: Evaluating Factors Affecting the Installation of Specific Ballast Water Treatment Systems on the Applicable Fleets and Vessels within the Designated Timeframes. (Facilitator: Dale Bergeron)
>
> Work Group 3: Review and Assess Current Verification Capability for Treatment Systems to Comply with a Discharge Standard of 100x IMO. (Facilitator: Dr. David Reid).

Full reports from these sessions are available in Appendix I. Each group developed a 15-minute summary to close out the Great Lakes Ballast Water Collaborative meeting.

Group 1 reported the that "commercially available" has a muddy definition. They discussed a table of BWTS options and spent time talking about IMO final approval and type-approval, Flag Administrations, U.S. final rule, timing, and what the Canadian government is going to require since they ratified the IMO Ballast Water Convention. One point of discussion focused on whether carriers can put a system onboard today or if they need to wait for USCG approval. What is commercially available can be classified by:

- Regulatory approval;
- Production components;
- Operation acceptability for particular vessels (freshwater, dwell time for active ingredients).

The group reiterated a common theme that having USCG proposed protocols would be very helpful. They discussed standards for saltwater verses freshwater, and U.S. verses Canada. Encouraged by the CSL presentation regarding the potential risk of transfering invasive species in Great Lakes ballast water and workable solutions for existing lakers, they pondered risk assesment for lakers thinking that maybe the Collaborative could come up with a compliance schedule beyond any due dates based on risk.

Group 2 worked under the assumption that a treatment system 100x IMO is commercially available and that their objective would be to get it onto a ship. Their discussion, spanning idea-to-complete installation, will feed a flow chart illustrating the process. Specific factors and steps that come into play were identified, as were sticking points (i.e. regulatory uncertainty was considered paralyzing) and opportunties (states could normalize their regulations; regulatory consistency would simplify the problem). A time-line conversation suggested that the process of selecting and installing a BWTS would take 3-5 years once a decision to install a system has been made.

Group 3 addressed the major question of: "Can scientists currently verify that BWTS can comply with 100x IMO standards?", and they also considered three specific work objectives, and several associated action items. To address compliance monitoring and future testing they referenced 11 articles published in the last 2 years (since 2008). They expect the number of available articles to continue to grow dramatically in the next several years. U.S. and Canadian scientists participating in the work group explained the IMO (G2, G8, G9) protocols, California testing guidelines, etc. Two certification reports were also listed on a handout document for the Group 3 discussion. Their dialog covered current available testing protocols and facilities, and the necessity of collecting data in a transparent way. Limitations with physical sampling continue to hamper verification testing, making ship-based compliance monitoring considerably more challenging than land-based verification testing.

NOTE: *The summaries from the three "Working Groups" reflect the discussions that were an actual part of the break-out sessions of the day (participants of each work group are listed).*

Dialog on various elements of "work group" discussions naturally continued after the official meetings. Individual work group participants were encouraged to submit personal comments (those not discussed by the entire work group) directly to the WDNR to further inform its permit deliberations.

CONCLUDING REMARKS

Middlebrook concluded the meeting by posing the question of "Where do we go from here?" He summarized the two-day meeting by noting three paths forward, all with the ultimate goal of trying to get to effective and workable effective ballast water management solutions and regulatory certainty "sooner rather than later." He noted that each of these paths for reaching desirable outcomes are concurrent rather than sequential:

1) Addressing the immediate ballast water regulatory landscape covers the next 6 months to 2 years and is focused at the moment on assisting the WI Department of Natural Resources in its efforts to produce a feasibility report by the end of the year. Other stakeholders are paying close attention to Wisconsin and how it will choose to proceed, and the year-end WI DNR feasibility report will attract a lot of attention.

2) The longer-term regulatory and technological landscape covers the next 2 to 5 years. It will likely take that long before there is a comprehensive legislative, and/or regulatory ballast water framework in the U.S. Such a framework would cover such primary issues as applicable standards and verification/testing protocols. It is only with such a framework that the technological solutions offered by emerging ballast water treatment technologies can be fully realized as well.

3) Finally, there is the medium term, which falls somewhere between the first two paths and seeks an "interim" solution through more immediate risk-mitigation measures until the longer-term comprehensive framework described above can be put in place and effective BWTS are developed. Middlebrook stated that a lot of the discussion at this meeting focused on this path. For example, there was Jeff Stollenwerk's idea of developing some form of "administrative agreement" between the states and industry stakeholders, as well as the CSA/LCA proposal to explore immediate risk-mitigation measures, and finally, there is the USCG's STEP program and facilitating the better use of this program.

Middlebrook noted that the BWC can – and is – making a tangible contribution to each of these efforts. He remarked that by bringing together key stakeholder representatives and experts, the Collaborative is trying to help key decision makers make better-informed decisions, and to allow them to make these decisions sooner, rather than later.

Regarding possible next steps for the BWC, Middlebrook stated that the primary focus right now is on assisting the Wisconsin DNR in preparing its feasibility report. This includes concluding the information-gathering work of the three work groups that met during the meeting. Second, would be to focus on the proposals for immediate, interim risk-mitigation measures that were brought up during the meeting by Jeff Stollenwerk, Bruce Bowie, Dr. Richard Everett and Cmdr. Gary Croot. Finally, and more generally, Middlebrook asked the members of the Collaborative to be attentive to opportunities where the forum provided by the BWC could be used to educate and inform as part of the effort to achieve greater regulatory stability and meaningful environmental protection until the regulatory framework, scientific knowledge, and technological capabilities arrive at the level where everyone would like them to be.

Middlebrook thanked the Collaborative's EPA hosts and asked for last thoughts from the floor. A Great Lakes fleet representative asked if *commercially available* included costs or if *commercially available* really meant available to military vessels with much bigger budgets. Sylvester said that costs would fall under operational function.

The group agreed with the suggestion that regulatory stability and the availability of BWTS that could effectively protect freshwater environments would significantly advance ballast water management in the Great Lakes. Three paths forward (each with different timelines) include:

1. Coordinating the immediate regulatory landscape (States and Canada align rulings); this could take 6-12 months.
2. Improving the regulatory and technology landscapes (USCG, EPA, vendors, shippers); this could take 3-5 years.
3. Work to mitigate environmental risks in a regulatory environment that has enough stability not to put the industry out of buisness (or thereby exacerbate other harmful environmental impacts through a modal shift); this is an intermediate strategy and need.

When a participant asked if state regulatory bodies in the Great Lakes could agree to accept USCG STEP applicants, Stollenwerk answered that the benefits of getting treatment systems onboard ships sooner rather than later are clear. He said, "While we can't know for sure if ships in the STEP program will meet state standards, we hope states will see this as a necessary effort toward the goals of minimizing AIS movement."

Cmdr. Croot said that through STEP the USCG would "like to move the puck down the ice." He reminded participants that there would be a STEP training program at the EPA laboratory the next day. Having a robust STEP program in the Great Lakes will help ship owners make better BWTS selections when facing significant factors and constraints. He said, "We would like a variety of vessels enrolled in STEP. I'm not going to tell you that the application is an easy process that you can do over a few beers." And then he joked that a few beers probably wouldn't hurt. He suggested that maybe states could enter into regulatory aggreements with carriers such as Consent Agreements.

It was suggested that testing facility personnel and the USCG meet in the near future to discuss BWTS approval processes. Dr. Everett (USCG) agreed that it was a good idea for people involved in testing to have a free and open discussion about what works and what doesn't, but said the USCG can't get involved in this discussion before the final ruling is put in place (but they can talk about testing procedures). Cangelosi said this discussion is happening on an international level and Dr. Drake reiterated that facilities in the U.S. are poised to test to IMO standards, not beyond.

With the cascade of new information, participants thought it was important to keep incorporating the new information into regulations, expectations, testing, installation, etc. The next step for the Collaborative was proposed: focus on the ideas put forward at this meeting to help provide regulatory stability and environmental protection while the USCG prepares the final ruling; and assist Great Lakes Carriers with their immediate efforts to better understand and mitigate specific AIS risk.

APPENDIX I

Ballast Water Collaborative Duluth Working Group Reports

APPENDIX II

Meeting Handouts

APPENDIX I
BALLAST WATER COLLABORATIVE DULUTH WORKING GROUP REPORTS

WORK GROUP 1

Identification of "Available" Ballast Water Treatment Systems "Rated" to Meet or Exceed 100x IMO.

Work Group Chair: Susan Sylvester
Facilitator: Dr. Marvourneen Dolor
Note Taker: Amy Schmidt

Participants: Dr. Ryan Albert (U.S. Environmental Protection Agency)
Robert Dorn (Interlake Steamship)
Dr. Richard Everett (United States Coast Guard)
Capt. Ivan Lantz (Shipping Federation of Canada)
Alicia Lenis (Seaway Marine Transport)
Paul Reader (Transport Canada)
Jon Stewart (Maritime Advisor)
Scott Smith (U.S. Geological Survey)
Chris Wiley (Fisheries and Oceans Canada) (phone).

BACKGROUND:

Following the Ballast Water Collaborative meeting on May 18, 2010 in Montreal, WI DNR generated a table which combined information from nine sources, in an effort to identify potential available Ballast Water Treatment Systems. Nine systems have received Type Approval Certification based on the IMO standards: Alfa Laval Pure Ballast, GLO En Patrol, Hyde Guardian, NEI Treatment, NK-03 Blue Ballast, Ocean Saver, Opti Marine, SEDNA – PeraClean, and Techcross. An additional 45 treatment systems are currently at in the process of being evaluated for Type Approval.

Some systems have received Type Approval based on testing performed in brackish and salt water. This approval may not be valid when the vessel is operating in the Great Lakes if the treatment mechanism requires salt water or if the active substances do not degrade rapidly enough after discharge into the colder waters of the Great Lakes. The US Coast Guard is considering these scenarios and will address this issue when their final rule is published.

There were two fundamental questions that the work group needed to answer:

1. What does commercially available mean?

A working definition of "Commercially Available" was offered which consisted of sub-definitions:

Regulatory Availability

- What regulatory regime is being considered? National Invasive Species Act (NISA) or the Clean Water Act (CWA)?
- Does the system meet the specific regulatory requirements under the regime being considered?
- Under CWA: Does the discharge meet State discharge limits? Note that there is no requirement for Type Approval.
- Under NISA: Is it Type Approved for the conditions it will operate under (e.g. salinity and temperature characteristics?
- Does the system meet class society requirements? This may overlap with regulatory requirements but may exceed them as well. Class requirements involve insurability.

Commercial Availability

- Is there a company that produces the system and is able to deliver and install it?
- Is there more than one vendor to purchase systems from (i.e is there enough competition to make it a viable market-place?)
- Are enough units manufactured per year sufficient to meet the demand?
- Is the cost of the system and/or operation and maintenance a factor?
- Does the system need to be available at more than one location world-wide?

Operational Availability

- It is appropriate for the specific vessel and its trade routes?
- Is there land-side technical support for maintenance and/or repair?

2. Do these treatment systems achieve the Wisconsin Standards?

- **What are the appropriate criteria for determining whether a system can achieve compliance with the WI discharge standard?**
  - **Criteria**
  - **Thresholds**

There are no testing protocols for evaluating whether or not a system can achieve Wisconsin's discharge standard (i.e. 100x IMO). This means that although treatment manufacturers are claiming that their systems are capable of achieving WI discharge standards there is high degree of uncertainty regarding these claims. Note that Wisconsin has a discharge standard and does not require that a system must be installed on a vessel. This led Scott Smith of USGS to propose another approach: Best Available Technology. Scott explained that this approach would provide a little more "wiggle room" for a given treatment to achieve the discharge standard. A technical standard as well, would supply a dose of chemical to kill all organisms.

- **Since USCG protocol for approval has not been adopted, and may not be available for years, what else can be used? What other approval is acceptable?**

There are no Flag administrations providing type Approvals for standards stricter than those outlined in the IMO convention. For Wisconsin's permit, if the 100x IMO discharge standard cannot be met, the permit defaults to the IMO standard or the 100x IMO date is extended.

As mentioned above, States cannot require a treatment system be installed; they can only regulate what is discharged from a vessel. Another point reiterated throughout the discussion was the fact that only the US. Coast Guard can provide Type Approvals for systems installed on U.S. flagged vessels.

WORK GROUP 2

Evaluating Factors Affecting the Installation of Specific Ballast Water Treatment Systems on the Applicable Fleets and Vessels within the Designated Timeframes.

Work Group Chair: Jeff Stollenwerk
Facilitator: Dale Bergeron
Note Taker: Sharon Moen

Participants:
- Noel Bassett (American Steamship Co.)
- Bruce Bowie (Canadian Shipowners Association)
- Cmdr. Gary Croot (United States Coast Guard)
- Steve Fisher (Great Lakes Ports Association)
- Phyllis Green (NPS - Isle Royale Nat. Park)
- Dr. Carolyn Junemann (U.S. Maritime Administration)
- Eric McKenzie (Seaway Marine Transport)
- Bill Lind (American Bureau of Shipping)
- Jen Nalbone (Great Lakes United)
- Eric Nygaard (Ohio Environmental Protection Agency)
- Julie O'Leary (Minnesota Environmental Partnership)
- Georges Robichon (FedNav, Ltd.)
- Mark Rohn (Grand River Navigation)
- Gregg Ruhl (Great Lakes Fleet)
- Jim Sharrow (Port of Duluth)

Goal: Working from a vessel-owner's perspective, identify and evaluate factors affecting the installation of specific ballast water treatment systems on the applicable fleets and vessels within the designated timeframes.

[The group understood this was a hypothetical exercise only. For this "case study," the group operated under the premise that ballast water treatment systems meeting a discharge standard 100 times more stringent than IMO were commercially available.]

Key Components of the Installation Process (the Ship Owner perspective)

1) **When can/will a Ship Owner install a BWTS.** There must be sufficient certainty of the regulatory environment at both state and federal levels. No Ship Owner would consider installing a system on a vessel that has not received approval from USCG for use in U.S. waters, as well as being evaluated for crew and vessel safety by the appropriate Classification Society (necessity for insurance).

2) **Vessel Specific Evaluations.**
    a. The engineering and mechanical requirements to install BWTS during new construction is likely to be less complex than the retrofit of existing vessels (because the new-build vessel is being designed to accept a specific BWTS).

b. A “Life Cycle Analysis” and “Business Case” is required to determine the viability of each vessel in relationship to the cost of BWTS installation, whether new-build or retrofit (the “Business Case” for a new-build BWTS installation will be less complex than understanding the potential continued viability issues of vessels undergoing retrofit for BWTS).

3) **Requirements for selection of BWTS.** In addition to the certification requirements noted above, any system must have “PROVEN” ability to meet or exceed, mandated treatment standards for the specific vessel and route on which it is to be used.

   a. The system must meet the specific physical and logistical constraints of each vessel. In addition, ballasting flexibility must be assured, and the requirements for pump rate and volumes for each vessel must be considered (see pgs 29-33 of Ballast Water Treatment Advisory; ABS).

   b. The system must be readily commercially available.

   c. The Vendor must understand the marine environment and be a trusted supplier with the capacity to deliver and support BWTS in a timely fashion.

   d. The “Life Cycle” of the BWTS must be taken into account, as well as operating costs and crew training. Ideally, systems will be simple to install, operate, and maintain.

   e. The “technology choice” must be compatible with vessel footprint, physical structure, cargo compatibility, hazardous space requirements and electrical system demands.

   f. Onboard compliance monitoring for the system must be simple and effective to meet regulatory requirements.

   g. The system must be safe in terms of both vessel viability as well as potential crew exposures to hazardous chemicals, byproducts and/or operations.

4) **Each vessel will require “Design & Installation Drawings.”**

5) **Each system purchase will need to receive internal capital expenditure approvals and will then need to be accepted for financing by a fiduciary agent or institution (Bank).**

6) **Contractor selection for system installation will be required** (if not part of a package provided by the system vendor).

7) Scheduling of actual system installation for each vessel.

a. Delivery availability (concentrated demand) – The largest BWTS manufacturers such as Alfa-Laval will be capable of producing approximately 500 systems per year. With only 7 BWTS which have been type approved world-wide, and a world-wide demand of well over 50,000 systems, it will take several years to satisfy the demand. BWTS manufacturers will not over-prepare for this demand, as it will be satisfied within a relatively short time (5 to 7 years, or so) after which the only demand will come from new vessel construction, which is a "trickle" in comparison.

b. Will "Dry-Docking" be required, and what is the current schedule? For BWTS which do not require drydocking for installation, shoreside engineering design and installation capability will also be required to meet the 50,000 unit demand.

NOTE: This is not an exhaustive list, only key elements or steps in the required process for BWTS selection and installation. Four handouts were used as reference material to drive discussion by the group, and are included as addendums to this report:

1) ABS: Ballast Water Treatment Advisory;
2) Shippers Perspective: Installing an Onboard Ballast Water Treatment System;
3) Categorizing Vessel Types and Uses for work on Critical Parameters; and
4) Factors Affecting the Timing or Feasibility of Installation of BWTS.

Estimated timeline for fleet-wide completion of ballast water treatment system (BWTS) installation (36 to 60 months or 3-5 years)

Regulatory certainty established; Technology available.	*Vessel Specific Evaluations*	*BWTS Selection*	*Design & Installation Drawings*	*System Purchase*	*Installation Contractor Selection*	*BWTS Delivery and Installation*
BEGIN	***3-6 months***	***3-6 months***	***12 months***	***3-6 months***	***3-6 months***	***12-24 months***

Meeting Discussion Summary

Working Group Introduction

Jeff Stollenwerk (discussion leader) and Dale Bergeron (facilitator) opened the meeting. After introductions, Jeff Stollenwerk reiterated that the primary objective of the workgroup was to provide information for the State of Wisconsin on the specifics of vessel function and structure that might impact the timing of installation of ballast water treatment systems. The Wisconsin Department of Natural Resources is attempting to determine if there are commercially available Ballast Water Treatment Systems (BWTS) which are capable of meeting a standard 100 times more stringent than the International Maritime Organization (IMO) standard and if technology is available to verify compliance with the more stringent standard. New-built ships would be required to have BWTS by 2012. If the determination passes, Wisconsin would require older ships to retrofit BWTS onboard by 2014. At this time, Great Lakes-bound ships (Lakers) are not part of that determination. However, the State of New York is conducting a similar internal assessment regarding BWTS for ocean AND Great Lakes vessels. They have to make a similar determination with regard to extension requests addressing their Clean Water Act 401 Certification requirements.

Three handouts (attached) were distributed to the group:

- Shippers Perspective: Installing an Onboard Ballast Water Treatment System
- Categorizing Vessel Types and Uses for work on Critical Parameters
- Factors affecting the timing or feasibility of installation

Jeff explained that the group would be developing two work products:

1. A high-level flow chart which addresses considerations and constraints for installation of a BWTS onboard a ship.
2. Specific factors that come into play affecting feasibility and installation, and timing.

The group understood that they were talking about installing something that doesn't necessarily exist for treating freshwater in the Great Lakes. However, they gamely accepted the following underpinning, hypothetical assumptions, in the interest of the ensuing discussion.

1. Commercially available technologies exist.
2. The U.S. Coast Guard has type-approved the BWTS.
3. The BWTS can fit on a ship.
4. A BWTS standard exists, whether it is IMO's or some other standard.

The discussion opened with Eric McKenzie and Noel Bassett talking about their contributions to the "components of the flow chart" handout.

The shippers said that their initial, typical, response to whether they could install a particular BWTS would be, "Well, what type of ship are you taking about?" They and the United States Coast Guard representative, Cmdr. Gary Croot, said vessel type is critical to what may or may not be installed. (See modified handout, Categorizing Vessel Types and Uses for work on Critical Parameters). The age of the vessel is also a consideration.

Carolyn Juneman asked, "At what point does the ship owner say, 'It's time?'"

"We're in the world of now," answered Phyllis Green. "It's now."

FedNav evidently thinks the time is now, too; Georges Robichon said FedNav's newest saltwater fleet is being built with room for BWTS. Noel Bassett said American Steamship Co. accepts the idea that there will be some form of BWT required in the near future. Gregg Ruhl commented with respect to the Great Lakes Fleet, “To be honest, we wouldn’t want to waste money and do more than is necessary until it is necessary.”

Eric McKenzie brought up a string of questions about specification requirements like: How big is the BWTS? What treatment method(s) does it use? When and where could it be installed? He said, “We tie up for 3 months in winter but where are the contractors to install it? We’re having problems just finding contractors to do our winter maintenance.” He suggested that maybe they could put half a system on at first so the companies can make sure it works.

Jim Sharrow commented that it will be important when shopping for a BWTS to specify where the systems are being operated. What is the temperature range? What is the range of conditions? “If you’re shopping, you need to ask if this meets your needs,” he said. Ruhl expressed a hope that the Coast Guard and other regulators would type-approve the system(s) in advance for the operational conditions and the types of ships seen on the Great Lakes.

Ruhl’s comment prompted a conversation about the collision of two different regulatory approaches: EPA’s and the Coast Guard’s. The EPA (and states)don’t type-approve treatment systems but have achieved success in water pollution control by setting achievable standards and allowing industry to determine how best to make the control happen within their own unique situation. On the other hand, the Coast Guard conducts detailed analyses of treatment systems and if appropriate issues a type approval. This provides the industry an assurance regarding compliance if the system is operated properly. Stollenwerk said there were pros and cons for the EPA approach and for the USCG type-approval approach and suggested keeping the EPA model as an option.

The discussion touched on possibly building ballast-less ships or dockside ballast management systems. At this time, ballast-less ship technology isn’t perfected to a point where it is useful. An option for shore-based ballast treatment is being tested in Milwaukee but Robichon, for one, doesn’t think it will work. Sharrow said he stopped calculating how much a shoreline treatment system for the Duluth Superior Harbor would cost when he reached $1 billion. There is a shoreside ballast water treatment facility in Valdez, Alaska, however, it’s purpose was to accept ballast water from tankers which carry ballast water in their cargo tanks. The treatment facility is an oily water separator designed to remove oil from the ballast water. It is not designed to treat ballast water to remove organisms.

Steve Fisher asked if a vessel operator would be able to install a BWTS on a ship before the Coast Guard approved it. The answer seemed to be: they could, but it would be inadvisable (referenced red boxes on the Shippers Perspective handout). Under design drawings on the Shippers Perspective, a step “send to ABS and USCG” should be added.

The workgroup was asked to look at the ABS report (page 20), as a starting point for asking, “What’s different for the Great Lakes?” This fed into the discussion about the handout Factors affecting the timing or feasibility.

The group considered the biggest factor affecting installment to be Coast Guard type-approval. Shippers felt it would be financially foolish, and possibly a safety risk, for them to put a BWTS on a ship before the BWTS was type-approved by the Coast Guard.

Jen Nalbone asked, "If a system were put on, could it be traded out?"

Robichon replied, "Not in a practical sense." He went on to say that a 5-year grandfathering plan for retrofitted older vessels "is simply an insufficient amount of time" if the shippers were compelled to put unapproved system on ships. Given the current state of technology, Robichon felt that shippers on the Great Lakes would be unable to comply with state rulings.

Nalbone asked, "Should we look at modular/component systems?"

Cmdr. Croot explained that the Coast Guard will not type-approve to a standard other than a federal standard. For example, if Wisconsin wants a 100x IMO standard and that is not the federal standard, the Coast Guard will not be type approving to the 100x IMO standard. However, if vendors successfully put their BWTS through a rigorous testing procedure such as the ETV protocols promulgated by the EPA office of Research and Development, they might be able to legitimately claim "100x IMO standards". However, no such protocols presently exist to test to the more stringent standard.

Cmdr. Croot could not release when either the Discharge Standard of the ETV Protocols will be finalized and released to the public. However, once the Final Rule is published, Independent Labs and Test Facilities will begin the process of becoming certified to conduct tests in accordance with the ETV protocols. This process will likely take up to one year for most of the IL's and test facilities to complete, after which, they will be certified to begin the shoreside testing in accordance with the ETV protocols.

The Coast Guard has not yet established an enforcement and compliance regime for the Ballast Water Discharge Standard. It will likely consist of a records check to ensure the vessel has submitted the required documentation to the National Ballast Information Clearinghouse (NBIC); an inspection to ensure the vessel crew operated the system in accordance with the manufacturer's specifications; and an inspection of the equipment to ensure it is installed and being maintained adequately. Protocols for discharge sampling have not yet been finalized.

In Oregon and possibly California, regulators do go onboard to examine discharge when they think it is necessary.

Fisher urged states to make enforceable rules, NOT ones that violate Coast Guard rulings. Gary Croot said again that the BWTS needs to be effective, safe, and that the effluent needs to be environmentally acceptable. Stollenwerk reiterated that the Collaborative understands that inconsistent state regulatory standards are a big issue and that ship owners can't make decisions based on one state's standards. He said reason needs to be self-imposed by states and that different state standards are almost impossible to address on an ocean-going vessel. Then he asked, "As a lake carrier, however, isn't this more of a pain than an impossibility?"

Bassett replied, "No, a ship owner is going to design the vessel for the (most stringent) state requirement, which is New York at this moment."

The group agreed that ABS Americas did a "stellar job" of laying out questions for vessel owners to evaluate feasibility of installation. Their scope includes new and retrofitted ships. Bill Lind, from ABS Americas, offered three points for installation that an insurer is interested in:

- Can the BWTS physically be packed on the vessel?
- How many do you need?
- Will it affect economics?

"How about the tank we use on the Ranger III?" asked Green. "Nobody type-approves a tank, but how about the chemicals?"

Trade laws were considered relevant to the overall issue but beyond the scope of Work Group 2's discussion.

The lack of convenient testing facilities was felt to add a degree of uncertainty as does the conundrum of what testing needs to be done.

The conversation got back on track when the group was asked to examine the "Factors affecting the timing or feasibility" handout. They were asked, "How long does it take to get from standards, to implementation strategies? Say what is possible. Say what is not."

Review of Feasibility Sheet

A. Science and technology: shippers can provide a platform for testing on ships (participate in STEP); there are reliable guidelines for sampling ports (IMO protocol—G2).

B. Regulatory compliance: The Collaborative can encourage the Coast Guard to issue BWTS standards. The requirement for deep sea ballast exchange and the salt water flushing of NOBOB tanks to assure a minimum salinity level of 30 ppt is in force and effect and authoritatively verified for all ballast tanks in all salties seeking to enter the Great Lakes through the Seaway at Montreal. When Fednav and the Shipping Federation of Canada (representing salties trading in the Great Lakes) approached the USCG in the fall of 2007 requesting that it make mandatory its recommendation for the salt water flushing of NOBOB ballast tanks (to ensure consistency with Transport Canada's mandatory requirements) they came face to face with the prospect of a long federal regulatory process which, with the USCG's not objecting, was avoided through the willingness of the US and Canadian Seaway authorities to jointly enact and enforce enhanced ballast water rules/regulations for the start of the 2008 navigation season making the salt water flushing of all tanks in all NOBOBs mandatory. Therefore, since the start of the 2008 navigation season every ballast tank in every salty seeking to enter the Great Lakes, be it in ballast or not, has had its salinity level checked and if not authoritatively verified to be 30 ppt is either not permitted to enter the Seaway or its offending tank is sealed.

Green suggested that using a technology standard rather than biological standard for ballast management might expedite the Coast Guard's ruling.

(Julie O'Leary commented that working through this list will just yield another list of why nothing can be done. She was hoping for a more positive discussion. Stollenwerk replied that, while a positive perspective was appreciated, the point was to address Wisconsin's Yes-or-No question. If the answer is "No, BWTS technology cannot be installed on vessels in the Great Lakes at this time," there better be a good explanation and justification of why not.)

C. Vendor information: Vendors should be able to offer the information listed except maybe details about life-cycle costs (the technology is too new and untried). Mark Burrows suggested including a tonnage and stability check. "You have space requirements but nothing about weight and stability," he said.

Pumping volumes within the system's capacity are an issue related to space; keep this in mind. Even if it is a linear progression, as the numbers of BWTS add up, they might end up creating a giant footprint.

Nalbone asked if there is a quality assurance output device indicating that a system is operating in compliance. Answer: It is possible to tell if the system is running as it is designed but NOT if it is meeting a particular standard. However, for some systems, there may be secondary indicators which could indicate if the system is effective in killing organisms. The situation was likened to meeting sewage treatment standards where a simple test for residual chlorine was developed, a process control mechanism. (Mark Burrows remembered that there was a time when ships were putting port-a-potties onboard vessels.)

Lind suggested that the group write in Joe Fisher under "C" for engineering support. Sharrow spoke of crew safety concerns; "crew support will be necessary, mistakes will be made." Before installation, crews need training manuals, vendors will need to be vetted.

The installation will require some flexibility since some systems are on a skid and others are modular. If a system breaks, there will need to be a backup plan. Cmdr. Croot explained, "Unlike any other Convention, the Ballast Water Convention makes no allowance for break downs. Maybe this is where shore side treatment becomes an option." NOTE: "Emergency Dosing Strategies" may be an option to address BWTS failure, as noted earlier in the day's discussions but that is not presently permitted by the Convention. Reliability and redundancy need to be considered as does the possibility that if ballast tanks need to be coated to minimize corrosion due to chemical use, the process would add more time and expense to dry-docking and BWTS installation.

D. Physical characteristics of vessels: Vessel type and capacity are a big deal, especially when the issue becomes Lakers. It is not clear when and where the BWTS installation can happen; where is the shipyard space and BWTS installation expertise? Salties usually go to dry-dock in China. It was suggested that a retrofit BWTS installation might be doable while the vessel was afloat (however Robichon advised that as concerns the OceanSaver BWT system, of which he was quite familiar, each system sold to date was to be installed in new-builds undergoing construction in a shipyard and for retro-fits that system would require installation during dry-docking) but Cmdr. Croot said he would be surprised if this was the case for any Lakers due to size differences and complexity of pumping systems. However, due to the significant differences between the Laker fleet and ocean-going fleet in terms of ballast water capacities, pumping volumes and ballast system arrangements, thought many Lakers would require drydocking for installation of BWTS.

There was interest in the CSA/LCA route data and characteristics presented the day before to the entire group (see meeting notes) and what it might mean for the spread of organisms and ballast water treatment.

E. Time and method for installation: Some systems are installed by the vendor, other systems are installed by an agent (typically the shipyard). For example, the OceanSaver system is installed by the yard, not the vendor.

F. Business considerations: For FedNav, a ship's life is 20 years (consider amortization). BWTS are not resalable, mainly because they would be very costly to remove. However, a vendor should be able to estimate a life-cycle cost and offer a warranty. Vessel owners should expect the system to last the life of the vessel.

G. Classification society requirements/ impacts: & H. Liability considerations:
Lind said that ABS has drafted Class Society Requirements for installing BWTS that is coming out in a month. "We want to look at drawings of how systems are going to be installed," he said. Wisconsin has the drafted ABS list, which is written from a classification standpoint. Usually it takes about a month from submitting a drawing to approval; but this is a new component and ABS isn't sure how long engineering approval will take. Shippers stand to lose their insurance if operating without compliance to regulations. In order to expedite the insurance process, e-mail these three people at ABS with BWTS installment designs: Bill Lind, Charlie Dorchak, Yoshi Osaki.

After a short break, the workgroup reconvened to compile the report-out. They responded to the question, "When it's time to put treatment systems on vessels, what are the key issues, and how do they affect the timeline? Can it be done by 2014?"

Regulatory Uncertainty is the Largest Handicap.

The current regulatory environment is having an adverse affect on progress toward BWTS installation. A complex regulatory framework has been created through federal and state permits, legislation, and rulemaking. The Canadian government has ratified the IMO D-2 standards. Several US states have adopted ballast water discharge standards ranging from IMO D-2 to 1000 times more stringent than the IMO standard with implementation dates ranging from 2012 to 2016. The final requirements under the federal regulations issued by the US Coast Guard or the permit requirements issued by the US Environmental Protection Agency remain uncertain. The USCG is developing responses to the 3000+ comments received during the NPRM public comment period, and the USEPA is reviewing its technology-based effluent limit and water quality-based effluent limit determinations under its Vessel General Permit. This regulatory uncertainty is a major obstacle to achieving compliance with numeric ballast water discharge standards.

The group identified a number of promising opportunities that could provide incremental risk reduction without requiring significant capitol or operating expenses. However, until regulatory quiescence is achieved, it is unreasonable to expect ship owners to begin work to achieve a particular discharge standard that requires significant investment. Ship owners are unable to obtain financing and make capital expenditures without reasonable assurance that regulatory compliance will be achieved in all waters that they transit.

Two important steps in achieving regulatory certainty are:

1) The US Coast Guard should finalize at least Phase 1 of its proposed regulation. This will get us moving toward the IMO D-2 standard which represents substantial improvement over current conditions; and

2) The US EPA should complete its technology-based determination and water quality-based procedure analysis to establish numeric discharge standards in the Vessel General Permit.

Maybe the Collaborative could encourage Wisconsin to pursue agreements for high-risk situations, rather than regulate ballast at this time. Maybe they could recommend an interim technology standard or shoreline implementation while working on biological standard verification. Although there are biocide concerns, some standard of success needs to be viewed as acceptable. What standard and model is appropriate? It comes down to risk. What risk are you willing to live with?

Stollenwerk said that the EPA is very interested in having states normalize their discharge standards. National Academies of Science (NAS) and advisory group will likely have their recommendations on the method for calculating numeric water quality discharge standards prepared by June 2011.

The group calculated that from the time of a National standard and certified/approved technology being deemed available, the timeline for the installation of BWTS will still be 3 to 5 years. The exact timeline is hard to define since the regulatory and interim solution plans are nebulous. Green offered to put together a timeline for this component based on the Ranger 3's experimental system permit experience. Roughly, this included 6 months to review treatment options and scoping (pick one and send out for peer review); 6-12 months for contracting; and 18-24 months until installation (if the system required dry-docking, installation could have taken 7 years). Green said, "We're treating now because we're not using a ship-installed treatment." See attached report "Bridging ballast water treatment technology gaps: Moving from proof of concept to full implementation of Great Lakes Ballast Water treatment within 24 to 36 months."

Ruhl estimates that for the Great Lakes Fleet, it could take 18-24 months to select system(s) for a variety of vessels; 6-12 months to raise the capital necessary to install and operate the systems;

12 months to design the system's installation; 3-6 months for review (depending on application numbers) by ABS, the Coast Guard, and everybody else who needs to review it (some of the states might want to review compliance/certification). He said, "We use about two or three engineering firms in the Great Lakes. There are not a lot of them and only one dry-dock that is available to us, and only two that are physically possible for our ships. Oh yeah, and only one person in the Coast Guard has the authority to review BWTS at this time."

For ocean going ships, regular dry-dockings happen in China, by appointment, about every 2 ½ years.

Components/Systems Selection is a step, not necessarily one that lengthens the process. However, depending on what is selected, a ship owner may need to install a second sea chest to accommodate back flushing.

Construction and installation time could be a sticking point. A participant said, "It's not like you can go to Wal-Mart and pick one off the shelf. They are custom made. Where are all the systems going to come from?" This led to a discussion about the lead-time needed to book installation crews and for the orders to be filled. For example, an engine from a catalog took a shipper two years to get. It took another shipper 18 months to get a single bearing. These were catalog items, not custom-made BWTS.

The group estimated that it could take 1-2 years of lead-time for fabrication, delivery and installation for ONE system. Then, should more than one system be needed, the other systems will likely follow in another few months. It was said that most vendors are still in research and development; even those that are IMO certified, can only produce 2 or 3 a year, save for maybe AlphaLaval, the most successful vendor that has sold 100 systems operating on saltwater vessels. This brought up an interesting point. Cmdr. Croot suggested that from a vendor's perspective, "If I can produce BWTS for the worldwide market (40,000-50,000) or the narrower standard and fewer ships (i.e. 250 Great Lakes ships), would I even build a BWTS for use in freshwater? Probably not."

The group wondered how long it took to install other ancillary vessel components such as the sewage treatment systems and the self-unloaders? Evidently it takes a minimum of 6 months to physically get an AlphaLaval BWTS on a ship. Also, trade routes and ship types have huge impact on timing.

The group thought that incentives to speed up the installation process could include:

- Find technology to bypass dry-docking.
- Find simpler processes.
- Uniform and achievable standards.
- Develop interim measures.
- Create appropriate subsidies

Attachments –

Meeting Handouts

- Shippers Perspective: Installing an Onboard Ballast Water Treatment System
- Categorizing Vessel Types and Uses for work on Critical Parameters
- Factors affecting the timing or feasibility of installation

- **Shippers Perspective: Installing an Onboard Ballast Water Treatment System** (McKenzie and Bassett table)

List 1	List 2
❑ Determine final regulatory requirements	❑ Physical Space: determine if/how can the BWTS fit on the ship
❑ Create specification requirements	
o Capacity needs	❑ Electrical Power: determine how to power the BWTS based on ship's capacity
o Footprint limitations	
o Treatment method	
❑ Identification of systems that meet requirements	❑ Piping: determine what infrastructure will be required to operate the BWTS and if the ship can accommodate the new infrastructure
❑ BWTS review	
o Type	
o Required approvals	
o Cap ex	❑ Evaluate how the BWTS could impact cargo and discharge rates
o Op ex	
❑ Business case analysis	
❑ Selection of system or systems to shipboard test	❑ Evaluate use and risks associated with active ingredients with respect to crew, ship, USCG, and ABS.
❑ Develop test protocols	
❑ Develop design and installation drawings for shipboard test	
❑ RFQ – installation (shipboard test)	❑ Are unit components USCG/ABS "type-approved?"
❑ Schedule installation (shipboard test)	
❑ Install test system or systems	
❑ Monitor and test system	❑ Can the BWTS be efficiently and accurately monitored?
❑ Develop specification requirements for each individual class of vessel	❑ Installation Timing: Lead time? Where? How long does installation take? New underwater hull penetrations require drydocking.
❑ Receive Capital approvals	
❑ Complete design and installation drawings for each class of vessels	
❑ Regulatory approvals for installation and drawings	❑ Is the BWTS simple to operate? Will crew need special training?
❑ Procure BWTS systems	❑ Can the BWTS be produced fast enough to meet the demand?
❑ Develop installation schedule for fleet	
❑ Evaluate life expectancy of vessels	❑ What are the service needs of the components of the BWTS? Costs? Can vessel personnel perform them?
❑ Installation of BWTS system	
❑ Develop testing protocol	
❑ Demudding of vessels	

Special thanks to Eric McKenzie and Noel Bassett.

Categorizing Vessel Types and Uses for Work on Critical Parameters

There are a number of different categories that must be considered in determining the suitability of a ballast treatment system for a given vessel on the Great Lakes, including:

Ballast system arrangement and specifications: Ballast pumping rates and volumes vary greatly among different types of ships. It is useful to categorize vessels into certain groups:

- Foreign salt water ships
- Great Lakes wide beam ships with centralized ballast pumping and distribution systems- (typically 1000-footers)
- Great Lakes mid to handy size ships with centralized ballast pumping and distribution systems
- Any ship with a decentralized ballast pumping and distribution system
- Other- includes work boats, barges, research vessels, etc.

Trade route specific ships:
The particular trade route of the ship may affect the need to perform ballast water treatment. Ballast water retention time associated with the trade routes of the ship will directly affect the suitability of certain treatments for a particular ship.

Ship's life cycle and economic considerations:
At what point during the ship's life cycle is the investment to be made? Can the marketplace afford the ballast water treatment?, or will the ship be laid up and scrapped?

Special thanks to Jim Sharrow.

Factors affecting the Timing or Feasibility of Installation

The following areas and issues of concern are proposed to jumpstart the discussion:

A) Science & Technology
   a. Testing/Sampling Equipment and Access
B) Regulatory Compliance
   a. Sampling set-up for new builds
   b. Time and Local for System Installation
   c. Other physical parameters…
C) Vendor Information
   a. Treatment Methodology/ Applicability
   b. System Capacity
   c. Impact on "Normal Operation"
   d. Space Requirements
   e. Equipment Durability/Limitations
   f. Power Requirements
   g. Corrosion Impacts
   h. Handling & Operations (control & monitoring)
   i. Certification/Indemnification
   j. Ability to Deliver and Support Products
   k. Maintenance and Life Cycle Costs
D) Physical Characteristics of Vessels
   a. Vessel Type and Capacity
   b. BWMPs
   c. Ballasting Characteristics
   d. Vessel Service/Route Characteristics
   e. Ballast System Design (configuration/space and tank/piping characteristics)
E) Time and Method for Installation
   a. In-service VS at Dry Dock
   b. Plug-in VS Redesign/Rebuild
   c. Vendor or Agent Install
   d. Electrical and Mechanical Issues
   e. Controls & Monitoring
F) Business Considerations
   a. Access to Capital
   b. Impacts on O&M
   c. Ability to Amortize
   d. Life Cycle of Vessel and Long-Term Strategic Plan
   e. Degree of Liability (vendor indemnification/port state certification)
G) Classification Society Requirements/Impacts
   a. Maintaining "Insurability"
   b. Impact of "ignoring" regulatory mandates
H) Liability Considerations (opportunity for mitigation through HACCP: Hazard Analysis and Critical Control Points)
   a. Who will design, train, and monitor?

WORK GROUP 3

Review and Assess Current Verification Capability for Treatment Systems to Comply with a Discharge Standard of 100x IMO.

Work Group Chair: Dave Adams
Facilitator: Dr. David F. Reid
Note Taker: Paul Luebke

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Goal: Review and Assess Current Verification Capability for Treatment Systems to Comply with a Discharge Standard of 100x IMO.

As part of the July 2010 Great Lakes Ballast Water Collaborative meeting, staff from the three U.S. land-based ballast water testing facilities, representatives from the states of WI, NY, CA, and MI, two treatment developers, several shipping interests, and interested stakeholders met in an effort to gather documentation and present and discuss professional opinions relevant to the goals and objects noted herein.

Objectives:

1. **Assess current testing protocols and facilities considered necessary to type test to 100x IMO.**

Meeting Discussion Summary: Type approval testing of ballast water treatment systems is critical to showing that a system can meet an established discharge standard. At this time, the most current protocols available for land-based and shipboard verification are the IMO documents commonly known as guidelines G2, G8, and G9, which provide guidance for land-based and shipboard testing of ballast water treatment systems and for compliance monitoring. However, these (IMO) guidelines were developed to verify system performance only to the level of the IMO D-2 discharge standard, and the methods and procedures to test to the D-2 standard are still being refined at the U.S. facilities. These methods and procedures <u>may</u> be relevant for testing ballast water treatment systems capable of meeting a discharge standard of up to one order of magnitude different from the IMO D-2 standard, if sampling approaches and volumes are adjusted to provide acceptable statistical confidence. Efforts are underway to harmonize methodologies for test facilities globally. The U.S. Environmental Technology Verification protocol is being finalized for verification of ballast water treatment systems' performance at land-based test facilities in conjunction with U.S. regulatory agencies. The ETV protocol is much more detailed than the IMO G2, G8, and G9 guidelines, but it is currently confined to land-based testing. There are currently no established protocols for verification of ballast water treatment systems performance to the more stringent Wisconsin discharge standards (100x more stringent than the IMO D-2 discharge standard), and ballast water treatment systems performing to the 100x IMO standard have not yet been conclusively demonstrated. Shipboard type approval testing poses a separate set of challenges, and the feasibility of designing type approval tests on ships to detect treatment performance to higher treatment standards with acceptable statistical certainty has yet to be determined. Thus, there are significant issues that will need to be resolved if testing or compliance monitoring to the more stringent Wisconsin Standard (100x more stringent than the IMO D-2 discharge standard) is to become possible and practical.

Conclusion(s): While progress has been made in the development of detailed testing protocols and harmonization among test facilities globally, there are currently no established protocols for, nor facilities capable of verifying ballast water treatment systems performance to the more stringent Wisconsin (100x IMO) discharge standard.

2. Identify approaches to meeting intensified verification needs associated with 100x IMO.

Meeting Discussion Summary: Existing land-based facilities have been designed to test the ability of ballast water management systems to achieve the IMO D-2 discharge standard using the guidelines of the IMO G8, G9, and ETV documents. It has been postulated that use of larger sample volumes and additional replicate trials will make it possible for facilities to test systems to more stringent standards, such as the Wisconsin 100x IMO discharge standard; however, these approaches are still being studied and have not been statistically verified, and their practicability, feasibility, and associated costs have not been evaluated. Test facility experts in Working Group 3 were unanimous in stating there are no accepted testing protocols presently available to deliver acceptable statistical confidence at the level of a 100x IMO standard. In addition, the test facility experts stated that because accumulated testing errors would be larger, resolving the problem through sampling and analyzing larger volumes of water may not prove to be a valid approach to achieve the necessary statistical confidence. For example, representativeness will decline due to increased organism mortality as time to conduct the biological analyses increases, resulting in greater uncertainty and less statistical confidence. The scientific experts stated that testing to a more stringent standard would be very difficult and is not presently possible, as no appropriate and experimentally verified protocols for this presently exist. One technology developer presented multiple test results for their treatment system (tested using IMO D-2 guidelines) and stated their opinion that these results are indicative of meeting 100x IMO Standards. However, the scientific experts expressed their opinion that no ballast water management systems have been verified to meet a discharge standard 100x more stringent than the IMO D2 standard with the necessary level of statistical confidence, by either land-based or shipboard testing.

Conclusion(s): Approaches to meet WI 100x IMO verification and compliance monitoring are theoretically possible, but not presently practicable, nor verified, due to existing facility and analytical limitations and incomplete R&D on this issue.

3. **Assess current compliance monitoring protocols and facilities considered necessary to spot check to 100x IMO.**

Meeting Discussion Summary: The group agreed that compliance monitoring under a 100x IMO discharge standard might be accomplished using indicative metrics to identify gross failures of a ballast water treatment system, but only in very rare instances would it be possible to conclusively determine via compliance monitoring if a vessel met a 100x IMO standard. The scientific experts noted that no formal protocols are currently in place for compliance monitoring of ballast water treatment systems to any standard, including the IMO D-2 standard. Several concepts have been proposed by regulatory agencies as a result of ongoing monitoring projects, and efforts are underway to develop detailed guidelines for establishing formal compliance monitoring programs relevant to IMO D-2 standards. Thus, while no protocols are currently in place for compliance monitoring of ballast water treatment systems, monitoring for gross failure against Wisconsin's discharge standard could be possible. Development of ship discharge sampling apparatuses and sample port design required for compliance monitoring are underway at various test facilities, but have not been completed. Sample port design and testing specifically for Great Lakes ships is being conducted at GSI and will be trialed next year on 12 vessels. Mobile laboratories have been proposed as a means of standardizing and stabilizing implementation of analytical methods once regulatory agencies establish compliance programs.

Conclusion(s): Equipment, sampling, and analyses required for compliance testing to the D-2 standard are under development. There are no existing protocols for compliance monitoring against the WI 100x IMO discharge standard. Once appropriate protocols and facilities are developed, it is possible that compliance monitoring will be able to detect gross violations of the WI standard with acceptable statistical certainty.

4. **Identify approaches to meeting compliance monitoring needs.**

Meeting Discussion Summary: Shipboard verification testing of a ballast water treatment system is different from shipboard compliance testing. Compliance testing is likely to be indicative, but not conclusive, of compliance to a standard, although it could be conclusive in cases of non-compliance. Verification testing needs to be conclusive of compliance to the standard. The greatest limitations to compliance monitoring, with acceptable precision and statistical certainty, are the logistical challenges associated with handling very large-volume or extremely large numbers of small- volume water samples, and separating line contamination from procedural or analytical error at extremely low organism densities. Therefore, the ideal indicative compliance monitoring regime may be a combination of 1) administrative review, 2) continuous monitoring and data logging of appropriate treatment system indicators during system operation, and 3) targeted biological sampling to detect gross system failures.

Conclusions: Compliance monitoring should be viewed as a tool to detect gross failure. Compliance monitoring to determine conclusively if ballast water meets a discharge standard 100x more stringent than IMO is not currently practicable. The recommended approach is to combine administrative review, application of sensor technology to verify system functionality to specifications, and targeted biological sampling to detect gross system failure. The details of such an approach are yet to be developed.

References & Supporting Information:

Many of the documents listed in the References section at the end of this report were briefly described by the various group members familiar with them. Each member volunteered his or her interpretations of the basic concepts contained within each document.

Albert et al (2010), California State Land Commission (2010), and Dobroski et al. (2008) each provided reviews and/or assessments of the availability of ballast water treatment technologies.

Gollasch (2010) provided a summary of the results of an expert workshop on harmonization of methodologies for ballast water test facilities.

IMO MEPC G2 "Guidelines for Ballast Water Sampling", G8 "Guidelines for Approval of Ballast Water Management Systems", and G9 "Procedure For Approval of Ballast Water Management Systems That Make Use Of Active Substances", along with the draft "US EPA ETV Program Generic Protocol for the Verification of Ballast Water Treatment Technologies", are currently the most relevant protocols available for land-based and shipboard verification of Ballast Water Treatment Systems (BWTS). Additional guidelines are provided via the IMO "Guidance for Administrations on the Type Approval Process for Ballast Water Management Systems in Accordance with Guidelines (G8)".

Lee et al. (2010) assessed the strengths and weaknesses of six existing and one new (proposed) approach to generating national organism-based discharge standards and applied a Poisson probability distribution model to sampling issues, especially volume requirements.

While not directly pertinent to the verification issue, two recent industry reviews of the status of BWTS were made available for review, ABS (2010) and Lloyd's Register (2010).

Lastly, it was mentioned that New York staff are preparing a paper for possible publication, which builds upon the concepts in Lee et al. (2010) to provide a basis for establishment of more formal guidelines for testing ballast water treatment systems to the Wisconsin discharge standard (100x IMO).

Goal Discussions & Supporting Information:

Review and Assess Current Verification Capability for Treatment Systems to Comply with a Discharge Standard of 100x IMO.

While the WI and NY regulatory programs do not plan to approve individual systems, neither are they dependant on the existence of a federal BWTS approval program. Individual states have the ability, through state legislation and regulation, or by the use of conditions within letters of certification to the EPA VGP under the Clean Water Act, to require the installation of appropriate technology to meet specific ballast water discharge standards, with verification being a separate issue. (Dave Adams)

Third party certification, such as from the American Bureau of Shipping (ABS) and Lloyd's Register of London (Lloyd's), have the role of assisting ships owners to insure that installed technologies are built and/ or installed according to specifications. These certifications may be completed prior to approval by the US Coast Guard. ABS and Lloyd's approve how something is installed, the US Coast Guard approves for safety. A ballast water treatment system could possibly be installed without US Coast Guard type approval, but with third party certification. (Bill Lind & William Peterson)

There is precedence for imposing standards beyond the capability of current monitoring methods. The limits for mercury discharges 10 years ago were below the analytical test methods level of detection and actual compliance couldn’t be confirmed. Today, now the test methods are available to quantify mercury below water quality standards so that true compliance can be verified. (Barry Burns)

Higher treatment standards have influenced technology development, now they may help in driving the test methods to verify treatment performance. (Allegra Cangelosi)

All treatment system vendors aim to kill everything, not just meet the IMO standard. They’re striving to achieve the "zero discharge" standard. (Mario Tamburri)

Ecochlor does not want to simply meet IMO standards of "10 organisms per cubic meter"; we want "zero viable organisms". (Charlie Miller)

Objectives Discussion & Supporting Information:

1. Assess current testing protocols and facilities considered necessary to type test to 100x IMO.

Type approval testing of ballast water treatment systems is critical to showing that a system can meet an established standard. Verification testing for the IMO D-2 biological performance standard is difficult. There are significant issues for testing to the more stringent Wisconsin Standard of 100x IMO. Non-detection of live organisms across the board would be a first indicator of possible performance beyond the IMO standard, but this outcome has not yet been demonstrated or achieved. That is, no ballast water treatment system for which type testing data are available has performed so well as to indicate possible compliance with the 100x IMO standard. (Allegra Cangelosi)

National land-based BWTS testing facilities include the Great Ship Initiative (GSI), the Maritime Environmental Resource Center (MERC), and the Golden Bear. The Navy Research Lab (NRL) facility in Key West currently focuses on protocol development; no routine testing of BWTS is currently conducted. Other international facilities include the Norwegian Institute for Water Research (NIVA), the Royal Netherlands Institute for Sea Research (NIOZ), and facilities in Japan and Korea, although they are all not necessarily independent like the US domestic facilities strive to be. More ballast water test facilities may come into being in the future, including third-party units. The need for additional test facilities is questionable, but will be market (profit) driven by vendors. (Lisa Drake & Allegra Cangelosi)

All facilities are currently testing to the IMO discharge standards only. Current testing protocols can identify gross failures, but can't verify compliance to 100x IMO discharge standards. Changes to protocols, such as many more replicates or use of alternative indicators, and facility infrastructure, or both, could allow facilities to accommodate that objective. The questions are, at what cost, to what level of precision, and is it worth it? (Allegra Cangelosi)

The IMO G2, G8, and G9 guidelines, along with the draft ETV Protocol, are the most current protocols available for land-based and shipboard verification of BWTS. IMO guidelines are interpreted by Administrations; they are guidelines, not regulations. (Mario Tamburri)

The current IMO guidelines recommend 3 consecutive successful shipboard tests, over at least a six-month period, with replicate 1 m^3 samples collected and entirely analyzed. The knowledge gained from land based testing can be applied to shipboard testing, i.e. sample port design. (Mario Tamburri)

The State of California (Dobroski et al., 2008; CA State Lands Commission, 2010) has interpreted existing land-based and shipboard treatment system test data to suggest that some presently available ballast water treatment systems have the potential to meet the CA discharge standard of "zero detectable organisms". (Nicole Dobrowski).

The World Shipping Council conducted a survey and concluded that no ballast water treatment systems have demonstrated the ability to meet discharge standards of 100x IMO or 1000x IMO. (Joel Mandelman)

There are no statistically significant data showing that any ballast water treatment system by itself can exceed the IMO performance standard. (Mario Tamburri)

Land-based tests of the Ecochlor System found zero living organisms in 28 of 30 post-treatment test samples, with two additional tests having only 1 organism each. That is an average of 0.07 organisms/m^3. Ecochlor considers these results to be significant and to be indicative of meeting 100x IMO Standards. Our first shipboard test in July on the Moku Pahu in California, conducted under IMO protocols, showed that there were zero organisms at discharge after 24 hours. (Charlie Miller)

Ballast water treatment systems may be able to exceed protectiveness of IMO standards if the treatment system is used in combination with existing ballast water exchange practices. (Allegra Cangelosi)

This is a hypothesis that Canada plans to test with shipboard trials. It must be clarified that BWE + treatment will not result in a lower number of organisms discharged, rather, it is expected that invasion risk will be lower. Discharge standards reduce invasion risk by lowering propagule pressure. Other means to reduce invasion risk include altering the physio-chemical conditions of the environment to reduce survival. BWE + treatment is not expected to reduce the number of organisms surviving any treatment system, but may reduce the number of individuals expected to survive freshwater conditions in Great Lakes’ ports after discharge. (Sarah Bailey)

2. Identify approaches to meeting intensified verification needs associated with 100x IMO.

Verification monitoring needs to be more comprehensive, with continuous sampling, as opposed to "grab" samples (discrete sub-samples) which may be used in compliance monitoring. (Sarah Bailey)

To test that ballast water management systems meet the IMO D-2 discharge standard at MERC and GSI, a sample of at least 5 m^3 of treated water is concentrated (to ~5 liters) and tested for the presence of living organisms. Therefore, the entire 5 m^3 sample is evaluated. If a linear relationship is used for testing to standards 100x more stringent than the IMO D-2 standard, using the same approach, 500 m^3 of water would need to be concentrated (to ~500 liters) and evaluated. There are no facilities, or accepted protocols, for handling such sample volumes. Also, the time to conduct the biological laboratory analyses would cause significant delays resulting in unintended mortality. (Lisa Drake)

More errors in testing are to be expected when using larger sample volumes. (Mario Tamburri & Allegra Cangelosi)

The draft ETV protocol provides more detailed methods and guidance than the IMO G8 guidelines. It's impracticable, or possibly impossible, to test to 100x IMO with the same rigor contained within the ETV protocol using similar analytical approaches. (Lisa Drake)

The science is very young for ballast water biological compliance monitoring to the IMO standard. We don't yet know what can be done with measuring to the 100x IMO standard. (Sarah Bailey)

Combining of multiple tests may be a means of transcending this problem in some cases. Existing facilities may be able to provide indicative testing for 100x IMO, but not conclusive testing. (Lisa Drake & Allegra Cangelosi)

To sum, it is fair to say that type verifying to a strict standard at land-based facilities can indeed be done, if we choose to invest the necessary extensive resources to do so, or are willing to accept surrogate measurements to counting individual live organisms, but we cannot do so today in any reliable way. The methods have not been developed or verified. (Allegra Cangelosi)

A shipboard ETV verification protocol may need to be developed. It would likely be different from, but may share some aspects with, the US Coast Guard Shipboard Technology Evaluation Program (STEP), which promotes active shipboard ballast water technology use and development. (Lisa Drake)

3. **Assess current compliance monitoring protocols and facilities considered necessary to spot check to 100x IMO.**

Because of the unknowns with monitoring, the Wisconsin general permit doesn't contain any specific requirements for the biological monitoring for determining compliance with the Wisconsin standard. The permit requires the submission of a monitoring plan, which would be specific to the vessel and its onboard treatment system. We may accept the type approval test of a ballast water treatment system as sufficient verification with no additional shipboard compliance monitoring. (Paul Luebke)

There are significant differences in the handling of ballast water between oceangoing vessels and Great Lakes vessels. Oceangoing vessels may discharge over a period of 12 hours, and some may discharge ballast in route. (William Peterson)

The U.S. negotiating policy at IMO has been that if any portion of a vessel's ballast water discharge is found not in compliance, all the vessel's ballast water is considered not in compliance. This view is not shared by other administrations. (Lisa Drake)

California's vessel inspection consists of an administrative inspection to confirm ballast water exchange occurred. About 20% to 25% of the vessels are inspected to check for their ballast water management plan and ballast log. A salinity sample is taken, but that can be of limited value since all the vessels are oceangoing, but it will detect if a vessel was at a brackish port and didn't conduct mid-ocean exchange. We look for gross violations, emphasizing compliance and won't take enforcement action unless nothing is done. California may need to push its compliance dates back, but likely won't change the discharge standards. (Nicole Dobroski)

A multi-agency group (Transport Canada, USCG, St. Lawrence Seaway Corporations) currently conducts joint inspections of all oceangoing vessels headed for the Great Lakes. Vessels must inform Transport Canada officials 96 hours in advance of arriving at port by submitting their ballast water exchange report. Canada can instruct vessels to conduct another ballast water exchange if procedures weren't followed correctly. A visit to the ship is made on arrival to review ballast water management plans, ballast logs and to interview the crew for knowledge and reliability. The salinity of each tank is also measured. Biological testing of each vessel is not feasible, but sampling may be done if there are red flags with the administrative review or other issues. In the future, when BWMS are used, indicator tests for gross non-compliance may be conducted with a 1 m^3 sub-samples according to IMO procedures. Canada is not as concerned about the level of statistical rigor for compliance sampling, or if results will hold up in a subsequent legal battle – Canada's main concern is having the ability to stop ballast water discharges that pose an environmental risk. The assumption is that if there's a failure, the system will fail big. Monitoring for a gross failure of Wisconsin's discharge standard would be possible, although there is concern that setting the discharge standard at 100x IMO may result in a higher failure rate of treatment systems (e.g. higher rate of filter clogging or tears). (Sarah Bailey)

4. Identify approaches to meeting compliance monitoring needs.

The question is open as to what we should design for in-line sampling protocols. California does not have a volume requirement for determining compliance with our zero discharge limit (no detection). It could be one liter. The sample needs to be representative of what is in the ballast tank that's discharged, though. (Nicole Dobroski)

Biological testing of ballast water (counting living organisms) must be conducted within a couple hours. Compliance testing facilities will need to be located near the port of inspection, or there may be a need for mobile facilities. As with the current joint-inspection program, inspections should be done strategically at a 'choke-point' in the St. Lawrence River prior to Great Lakes' entry. (Sarah Bailey)

Ideally, protocols for compliance should be in place prior to implementation of a specific standard. For conclusive sampling, sample volume is dependent on the discharge standard used. Compliance monitoring may first start with an indicative sampling step (to test for gross exceedance) that will not determine conclusive achievability of any standard and then follow with a conclusive sampling step, if needed, to address the D-2 standard. (Lisa Drake)

Shipboard verification monitoring for a ballast water treatment system is different from compliance monitoring. Conducting scientifically valid procedures on board ship is very difficult since conditions cannot be controlled very well. Current compliance testing protocols can find gross failures with 100x IMO, but not verification of compliance. Compliance testing is likely to be indicative, whereas verification testing needs to be conclusive. (Sarah Bailey)

Indicative measures can be employed as an initial level of compliance monitoring. Sensor measurements of treatment system operational parameters, such as total residual oxidant levels for oxidizing chemical treatments and dissolved oxygen levels for deoxygenation treatments, biological measures such as chlorophyll levels using in situ fluorometers and perhaps estimates of ATP levels, could serve as rough indicators of the treatment system performance and a step that triggers more intensive biological sampling. (Mario Tamburri)

Use of ballast water treatment system operation indicators that show the system is functioning according to specifications could be the best approach to onboard monitoring. This type of monitoring would be more practical and reliable than biological monitoring of effluent for compliance with the discharge standard. Biological work-ups should still be undertaken however, in some percentage of monitoring events and for high-risk vessels. (Allegra Cangelosi)

Some onboard biological testing will be needed, but it should be used to demonstrate conclusively non-compliance. It will be next to impossible to demonstrate compliance conclusively with shipboard monitoring. (Mario Tamburri & Allegra Cangelosi)

The following matrix was developed in an attempt to show the various compliance monitoring scenarios.

Compliance Monitoring Scenarios

	Indicative (gross)	Detailed (conclusive failure)
"Grab" (Discrete Sub-sample)	Not Possible	Only if # of all organisms allowable in ship discharge are found in sample
**Time Integrated: Partial Discharge (e.g., 1 m^3/ 15 minutes)	May be used as a first approximation	Can show conclusive failure and will be more sensitive than the grab sample above, but false positive possible
**Time Integrated Entire Discharge	Applicable if some partial analysis is used, such as analysis for a subset of organisms in the discharge.	Can show conclusive failure and will be more sensitive than the grab or partial time-integrated sample, but false positives still possible.
Water Chemistry Operational Parameters	May be used as first approximation	Not Applicable

** Greater statistical rigor can be achieved assuming high quality sample and analysis requirements are met.

Resources

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APPENDIX II
MEETING HANDOUTS

Duluth Meeting agenda

Report from the Great Lakes Ballast Water Collaborative Meeting (Montreal, 18 May 2010)

Ballast Water Collaborative Duluth Working Groups

Description of process/expectations for work group breakout sessions

STEP Workshop, July 22, 2010

Ballast Water Collaborative Working Group Proposal: Exploring Measures to Further Mitigate the Risk of Spreading AIS with Existing Lakers