



Discussion on Current Guidance for Scaling of BWMS

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Topics

- Scaling of BWMS – current guidance
- Stakeholder concerns for installed BWMS
- Review of scaling
 - Existing type approvals
 - Shipowner BWMS experience
 - IMO Study on Implementation of D-2
 - Report on review of G8
- Scaling of BWMS – proposed improvements
- Scaling Model Considerations
 - Variables that affect performance and efficacy are inter-related
 - Should be included in modeling and validated during testing

Scaling of BWMS: Current Guidance

- Resolution MEPC.174(58) *Guidelines for Approval of Ballast Water Management Systems (G8) (October 2008)*
 - Downscaling for land-based testing (200 m³/h TRC for 200 m³ capacity):
 - 1:5 for 200 to 1000 m³/h
 - 1:100 for greater than 1000 m³/h
 - Larger land-based test scaling and lower flow rates used if evidence from full-scale shipboard testing proves the scaling and flow rates will not adversely affect D-2 compliance
 - Full-scale shipboard testing to confirm D-2 compliance
- 46 CFR Part 162 *Standards for Living Organisms in Ships' Ballast Water Discharged in U.S. Waters; Final Rule*
 - 162.060-28(e)(1)
 - Volumes and flow rates to be representative of the upper end of the treatment rated capacity for BWMS
 - “Vessel tank size and flow rates must be equal to or exceed those used during land-based tests”

BWM.2/Circ.33: Guidance on Scaling of Ballast Water Management Systems (August 2011)

- Where all models are land-based tested, the most vulnerable model should be tested according to the requirements for shipboard tests
 - The term “most vulnerable” is not clearly defined in the Guidance and no administration has published clear scaling guidance
- Shipboard tests for each scaled unit (3 months)
- If scaling and shipboard testing is utilized to approve a larger TRC:
 - Identify key internal/external performance parameters and specify conditions/parameters for these
 - Validated model and/or calculations to predict key parameters achieved in scaled unit and fundamental mechanism not changed
 - Shipboard testing to verify the scaled unit achieves the critical values of the key performance parameters
 - Model should address efficacy and environmental impact/actual byproducts should be measured during shipboard testing
- Representative number of scaled systems should be shipboard tested

Stakeholder Concerns for Installed BWMS

Shipowners/Operators

- Compliance with D-2 performance standard
- Minimize real costs

Regulators/Administrations

- Compliance with D-2 performance standard
- Inspection for compliance

Shipyards (newbuild and retrofit)

- Meet contractual requirements
- Achieve Flag and Class installation approvals
 - Compliance with Engineering plans developed from Administration type approval documents

BWMS Vendors

- Achieve Administration and Class Type Approval
- Meet contractual requirements

Review of Scaling in Existing Type Approvals

- Review of 47 type approval certificates provided to IMO by Administrations
 - Two have approvals specifying a greater flow rate for scaling
 - Most of the type approval testing has been conducted on models with treatment rated capacities (TRC) approximating 250 m³/h
- A review of published test information indicates that land-based testing has not been conducted above 500 m³/h and shipboard testing has been conducted at 1000 m³/h or greater TRC for only a few BWMS

USCG BWM Update (February 2016) stated that the USCG review of AMS found that “Scaling not per G8 (approx. 80%)”

Source: USCG Homeport BWM Program website

Shipowner BWMS Experience

- ABS has discussed BWMS operational experience with many shipowners over the past few years
- BWMS with lower treatment rated capacities ($<1,000 \text{ m}^3/\text{h}$) have achieved greater success in operation
- BWMS with capacities greater than $1,500 \text{ m}^3/\text{h}$
 - Limited success with commissioning of systems
 - Are requiring significant amount of time (i.e., up to 2 years) to get them operating
- Shipowners are concerned with getting the equipment to operate consistently. The ability to achieve the D-2 performance standard has not been the initial concern.

IMO Study on Implementation of D-2

- MEPC 67 endorsed a study on the Implementation of the D-2 Performance Standard
 - Track 1 – Similarities/differences in testing and certification
 - Questionnaire 2 – Administrations, other Government agencies and recognized organizations
- Q21 – How do you evaluate and certify BWMS for multiple units in a model series, sizes, and/or flow rates (system scaling)?
 - 1 in accordance with BWM.2/Circ.33;
 - 2 CFD analysis and mathematical modeling;
 - 3 use of land-based testing as minimum and shipboard testing as maximum for scaling systems; and
 - 4 manufacturer calculations

Study analysis: Respondents could select more than one option and the responses indicate that the approach under BWM.2/Circ.33 is the most commonly employed. Some Administrations rely on their recognized organizations to deal with scaling with no indication on how Type Approval Certificates are issued for the scaled units. Some responses indicated that certain Administrations deviated from the approach in BWM.2/Circ.33 in their evaluations.

Source: Final report on the study on the implementation of the ballast water performance standard described in regulation D-2 of the BWM Convention (MEPC 69/4/4)

MEPC 69/4/6: Report on Review of Guidelines (G8)

- Item 17 – Should all documentation relating to scaling of a BWMS be included in the test report, including the decision process following computer modelling, description of model assumptions and validation documents?
 - Concluded that guidance is already available in BWM.2/Circ.33
 - Agreed on a need for the circular to be reviewed to ensure that it remained relevant.
 - Include text and intent of the circular should be included in Guidelines (G8).
 - No text proposals were received.
 - Observations on BWM.2/Circ.33:
 - Include details of process and methods for scaling decisions
 - Clearly articulate number of models shipboard tested
 - Administration is to verify scaling (if models not tested)
 - Majority of group favored validation of modeling through full-scale shipboard testing
 - Identified scaling as an area for future work/outstanding items
- Typical type approval process looks at extremes and several points within the range (i.e., interpolation)
 - BWMS scaling under current guidance may use extrapolation

Suggested Improvements to Scaling

- Assess impacts on component reliability due to increased TRC
- Evaluate BWMS start-up impacts due to increased TRC
 - Increased piping sizes and internal volumes of piping – system warm up may result in untreated ballast water
- Determine impacts on neutralization sub-system
 - Shipboard installations can require remote TRO monitor with longer sample circulation piping
 - Longer piping can increase stagnant water causing differences between analyzed versus actual TRO
 - TRO monitor sample frequency and response variations

Scaling Model Considerations

- Specifications for major components should be evaluated to determine equivalence to support scaling BWMS
- **Example – Pre-Treatment (Filters)**
 - Vendors need to have multiple sub-vendors to support large numbers of BWMS orders and to accommodate retrofit installation challenges (some filters fit better than others)
 - Filter screens have very different organics, inorganics, and silt retention capabilities – nominal sizes (i.e., 40 μm) may not represent retention characteristics
 - Most limiting filter screen retention profile should be basis of mathematical models used for scaling

Land-based & Shipboard Testing

- Limitations from Land-Based and Shipboard Testing

- Standard operational time of 1 hour operation for 200 m³/h should be modeled to predict 12 hours in-service system operation for 2000 m³/h

- Ballast holding time – voyage durations longer for larger systems

- Treated water holding time not representative of operational use of BWMS
 - Smaller TRC BWMS are suitable for shorter duration voyages
 - Larger TRC BWMS for longer duration voyages
- Differences between tested holding times and in-service ballast voyages should be modeled
- ■ Thermal/solar gain of treated water in tanks – changes to residual active substance and **ACCELERATED REGROWTH** should be modeled

Final Points

- Shipowners/operators most accountable for scaled BWMS that fail to meet the D-2 standards
- Current guidance on scaling inadequate to address the shipowners/operators needs
- Vendors should consider more installation possibilities when developing mathematical models and computational fluid dynamics for scaling
- Use interpolation versus extrapolation for scaling



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